United States Court of Appeals
for the
District of Columbia Circuit

TRANSCRIPT OF RECORD

United States Court of Appeals
For the District of Columbia Circuit
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JOINT APPENDIX TO BRIEF FOR APPELLANT.

UNITED STATES COURT OF APPEALS
FOR THE DISTRICT OF COLUMBIA.

No. 11,735.

NATIONAL LEAD COMPANY, a Corporation,
New York, New York,
Appellant,

v.

ROBERT C. WATSON, Commissioner of Patents,
Washington, D. C.,
Appellee.

893

Appeal from the United States District Court for the
District of Columbia.

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JOINT APPENDIX TO BRIEF FOR APPELLANT.

COMPLAINT.

(Filed January 17, 1951.)

To the Honorable the Judges of the United States District Court for the District of Columbia.

Plaintiff for its Complaint alleges:

1. That Plaintiff, National Lead Company, a corporation of New Jersey, is a citizen of the United States and of the State of New Jersey, and resides and has a principal place of business in the City of New York, State of New York.

2. That Defendant, John A. Marzall, is a citizen of the United States, is Commissioner of Patents of the United States, maintains his official residence within the District of Columbia, and is sued in his capacity as Commissioner of Patents of the United States.

3. That this is an action arising under the patent laws of the United States, to-wit, Section 4915, of the Revised Statutes of the United States (Title 28, Section 63, U. S. Code); that no appeal has been taken to the United States Court of Customs and Patent Appeals, and that there are no adverse or opposing parties.

4. That prior to June 7, 1943, and March 11, 1946, Dee A. Sikes and Jack H. Beesley, citizens of the United States and then residents respectively of Tulsa, County of Tulsa, State of Oklahoma, and Great Bend, County of Barton, State of Kansas, invented certain new and useful improvements in Treatment of Well Drilling Fluids, for which they believed themselves entitled to Letters Patent of the United States. Said Dee A. Sikes and Jack H. Beesley, having complied with the requirements of the United States in such cases made and provided, filed in the United States Patent Office certain applications for Letters Patent of the United States, identified as Serial No. 489,890, filed June 7, 1943, and Serial No. 653,716, filed March 11, 1946; the said applications containing written descriptions of said improvements and particularly the subject matter of claims 11 through 15 and 17 of application Serial No. 653,716 in such full, clear, concise, and exact terms as to enable any person skilled in the art or science to which it appertains to make, construct, compound, and use the same; and said application Serial No. 653,716 particularly pointing out and distinctly claiming the subject matter of Claims 11 through 15 and 17 upon which they believed themselves entitled to Letters Patent, all of which will fully appear from a duly authenticated copy of said application to be produced in Court.

5. That on February 25, 1946, said Dee A. Sikes and on March 2, 1946, said Jack H. Beesley did duly sell, assign and transfer to Plaintiff, National Lead Company, its successors and assigns, the full and exclusive right, title and interest in and to said improvements as described and/or claimed in said application Serial No. 653,716 and in and to all Letters Patent and patent rights which may be granted or issued for said improvements; said Assignment being recorded on March 11, 1946, in Liber F206, page 296, in the United States Patent Office; of such assignment profert is made.

6. That thereafter such proceedings were had that said application was finally rejected by the Patent Office on August 27, 1948 as to Claims 11 through 17 thereof by the Examiner in the Patent Office in charge thereof; that thereupon Plaintiff within six months from August 27, 1948, to-wit: on February 4, 1949, appealed from said Examiner to the Board of Appeals of the Patent Office, complying in all respects with the provisions of the patent statute R. S. 4909 (Title 35, Section 57, U. S. Code), and the rules in such cases made and provided; that thereafter pursuant to the rules of the Patent Office said Examiner on July 13, 1949 rendered a written Statement purporting to set forth the grounds of his decision and all points involved in the appeal and furnished a copy thereof to Plaintiff; that Plaintiff submitted a brief in reply to said Statement of the Examiner in which the appeal of its Claim 16 was dismissed for reasons there stated; that thereafter on July 18, 1950, the Board of Appeals rendered a decision affirming the Primary Examiner and refusing the Plaintiff Letters Patent upon the subject matter described in said application, and particularly pointed out and distinctly claimed in said Claims 11 through 15, inclusive, and Claim 17; that thereafter on September 26, 1950, the Board of Appeals, on petition for reconsideration, affirmed its decision affirming the Primary Examiner; all of which will

appear from the file of said application Serial No. 653,716 in court to be produced and of which Plaintiff makes profert.

7. That Claims 11 through 15, inclusive, and Claim 17 so refused by the Patent Office set forth the subject-matter of Plaintiff's application Serial No. 653,716, which is in the secret archives in the Patent Office and in accordance with Rule 14 of the Patent Office is and should be preserved in secrecy, and that under Section 4908 of the Revised Statutes (35 U. S. C. 56), Plaintiff can refuse to disclose their subject-matter; said claims are, however, of record in said application, Serial No. 653,716, and the amendments thereto, which will be produced at the trial, and Plaintiff makes profert of the same.

8. That in consequence thereof, Defendant has refused and still refuses to grant Letters Patent on said application as prayed for in said application Serial No. 653,716, on said Claims 11 through 15, inclusive, and Claim 17, and on claims which are germane to the subject-matter now in issue and for which Plaintiff was legally entitled to Letters Patent.

Wherefore, Plaintiff demands judgment against the Defendant, the Commissioner of Patents, ordering and requiring the Defendant to grant unto Plaintiff the Letters Patent prayed for in the aforesaid application, Serial No. 653,716, on Claims 11 through 15, inclusive, and Claim 17, and such other claims which are germane to the subject matter as this Court may deem meet.

ANSWER TO THE COMPLAINT.

(Filed January 30, 1951.)

To the Honorable the Judges of the United States District Court for the District of Columbia.

1, 2, 3. The defendant admits the allegations of paragraphs 1, 2, and 3 of the complaint.

4. He denies that plaintiff has invented any new and useful improvement on which a patent might be granted. He denies that either of the applications referred to in paragraph 4 contained a sufficient disclosure of the subject matter of claim 17. He admits the remaining allegations of paragraph 4.

5, 6. He admits the allegations of paragraphs 5 and 6.

7. He denies that the plaintiff is entitled to preserve his alleged invention in secrecy during the pendency of this action. He admits the remaining allegations of paragraph 7.

8. He admits that he has refused and still refuses to grant to the plaintiff a patent containing any of the claims 11 through 15 and 17. He denies that the question as to a refusal of a patent on any other claim is germane to the present issue or properly before the Court. He further denies that the plaintiff is legally entitled to a patent containing any of claims 11 through 15 and 17.

Further Answering, the defendant states that plaintiff is not entitled to a patent containing any of claims 11 to 15, inclusive, and 17 for the reasons given and in view of the references cited in the statement of the Examiner in answer to the plaintiff's appeal, the Examiner's reply to the plaintiff's brief, and the decisions of the Board of Appeals. Profert of copies of the said statement, reply, decisions, and references is hereby made.

OPINION.

(Filed November 26, 1952.)

This is a civil action brought under the provisions of Section 4915 of the Revised Statutes (35 U. S. C. 63), in which the plaintiff, National Lead Company, as assignee of the inventors, Dee A. Sikes and Jack H. Beesley, seeks to have this Court authorize the defendant, Commissioner of Patents, to grant a patent to it based upon certain claims of the Sikes and Beesley patent application, serial number 653,716, filed March 11, 1946 on an alleged invention in the "Treatment of Well-Drilling Fluids." The Patent Office denied all claims.

Plaintiff says that the present application is a continuation of application, serial number 489,890, filed June 7, 1943, as to common subject matter. This Court held that the plaintiff, assignee also of the prior application, was not entitled to letters patent on the claims there involved. The Court found that the claims did not define invention over the disclosures of the prior patent of Cannon, number 2,109,858, granted March 1, 1938, and the prior publication of Stern, Bulletin No. R. I. 3556, Bureau of Mines, Department of the Interior, Feb. 1941. The United States Court of Appeals for the District of Columbia Circuit affirmed and a rehearing was denied September 4, 1952.

The claims before this Court are those numbered 11 to 15, inclusive, claim 16 having been withdrawn before the Board of Appeals of the Patent Office, and the plaintiff having dismissed claim 17 here.

The claims relate to a process used in the drilling of wells by the rotary system. In such drilling there is employed an aqueous mud-laden fluid, called a drilling mud. The rotary system involves the use of a drill pipe with a bit at the bottom. This bit is larger than the pipe in order to make the hole larger. At the top is a drill stem of squared section sliding through a rotary table. The whole of this section is suspended so that it can be let down into the bore hole. A drilling fluid, which is pumped down the drill pipe, issues at the bottom through holes in the bit. As the hole is cut, the drilling fluid, rising outside the drill pipe, carries the cuttings to the top where the fluid flows along a mud ditch and over a vibrating screen through which the cuttings are filtered. The fluid then passes to a suction pit where it is picked up by pumps for recirculation.

Claim 11 seems to be representative of the claims here and is as follows:

11. In the art of drilling wells through formations by the employment of an aqueous mud-laden well drilling fluid containing an amylaceous emulsoid colloid which is subject to deterioration during the course of drilling, the process, comprising, maintaining such a drilling fluid, during the course of drilling, at a pH of about 12 by addition thereto an alkaline earth metal oxide in order to inhibit such deterioration.

Plaintiff asserts patentability for a method of drilling a well which involves the use of a mud composition containing an anylaceous emulsoid colloid (gelatinized starch) at a pH (alkalinity) value of about 12, the pH value being obtained by the use of an alkaline earth metal oxide.

The basis of plaintiff's claim for invention in the prior application was that its assignors discovered that the results desired in the drilling fluid could be accomplished without fermentation of the gelatinized starch used for maintaining the viscosity (thickness-thinness) at such consistency as to convey the cuttings and also seal the bore hole by bringing the drilling fluid to a pH value of about 12 and maintaining it there during the course of the drilling. The claims did not specify any particular material for bringing the fluid to a pH of about 12 but the specification of the application in the prior case stated that any suitable alkali could be used for the purpose, and named caustic soda, caustic potash, caustic lithium, caustic ammonia and lime. This Court found in the prior suit that plaintiff claimed as invention the use of alkali, such as caustic soda, to maintain the alkalinity of the drilling fluid at a pH value of about 12 and found that the claims defined no invention over the disclosure of the patent to Cannon nor over the disclosure of the publication by Stern.

The Cannon patent relates to a drilling fluid which includes a starch and caustic soda. A 1% solution of the latter will hydrolize or gelatanize the starch. This Court found that the pH value of a 1% solution of caustic soda was just under 13.0. The Court also found that the publication of Stern had explained the use of hydrolized starch in a well drilling fluid and said that a pH of about 11.0 or 12.0 had been found desirable.

What then is the difference between the claims held unpatentable in the prior case and those before the Court now?

Plaintiff says that the present case distinguishes from the previous case in that the present claims involve a water clay gelatanized starch lime drilling fluid, while the previous case involved broadly the employment of any alkali in such water clay gelatanized starch fluid. The Board of Appeals of the Patent Office held that the claims in the present application differed from the claims in the prior application in the limitation that the alkalinity of the mud was established and maintained by the use of an alkaline earth metal oxide. It is clear to the Court that the claims here differ from the claims held unpatentable only in the statement that an alkaline earth metal oxide is used to bring the pH value of the fluid to about 12 or to maintain the pH value at about 12 during the course of the drilling.

In **National Lead Company Corporation v. Marzall**, No. 10873, ... U. S. App. D. C. ...., the Court held that patentability could not result from the discovery that gelatanized starch could be prevented from deteriorating in a drilling fluid by maintaining the alkalinity of the latter at about 12, since increase in the knowledge of the properties of a composition old in the prior art did not call for the grant of a patent. The Court cited **Roberts v. Ryer,** 91 U. S. 150.

In the light of Cannon's and Sterns' disclosures, knowing that a pH value of about 12 should be obtained, the selection of one of the compounds mentioned, which is capable of yielding a solution of a pH value of about 12, is not invention. Lime, an alkaline earth metal oxide, is specifically named by Cannon for achieving high alkalinity, and lime is the material now preferred by plaintiff. The use of lime, to reach the desired pH value of about 12 for the drilling fluid, would be obvious to any one skilled in the art and, therefore, not invention. Sterns discloses a hydrolized starch mud having a pH value of about 11 or 12. This starch is a pre-gelatanized starch added to the mud and brought to the necessary pH value by any desired alkalinizing material capable of so doing. Only the skill of the art is needed or exhibited by the selection of a relatively inexpensive caustic alkali for the job. It follows, therefore, that the claimed subject matter is clearly non-inventive in view of the prior art. The claims in suit are all process claims and the testimony produced at the trial fails to show clear error on the part of the Patent Office tribunals in refusing to grant any of the claims at bar. The Court, therefore, finds for the defendant and counsel for the defendant will prepare the appropriate findings of fact and conclusions of law not inconsistent with this opinion.

Edward M. Curran,
Judge.

FINDINGS OF FACT.

(Filed December 24, 1952.)

1. This is a civil action brought under the provisions of Section 4915 of the Revised Statutes (35 U. S. C. 63) in which the plaintiff, as assignee of the inventors Dee A. Sikes and Jack H. Beesley, seeks an order from the Court authorizing the defendant, Commissioner of Patents, to grant a patent to it based upon certain claims of the Sikes and Beesley patent application Serial No. 653,716, filed March 11, 1946, entitled "Treatment of Well Drilling Fluids."

2. The claims before the Court are those numbered 11 to 15, inclusive, in the application, plaintiff having dismissed claim 17 here.

3. The claims at bar, of which claim 11 is representative, relate to a process used in the drilling of wells by the rotary system, wherein there is employed an aqueous mud-laden fluid, called a drilling mud. The drilling mud is pumped down the drill pipe, and carries the cuttings to the top of the well, where the cuttings are filtered out prior to recirculation of the fluid in the well. Patentability is asserted for a method of drilling which involves the use of a mud containing an amylaceous emulsoid colloid (gelatinized starch) at a pH (alkalinity) value of about 12, the pH value being obtained by the use of an alkaline earth metal oxide.

4. The application at bar is a continuation as to common subject matter of application Serial No. 489,890, filed June 7, 1943. In that application the claim of invention was based upon the discovery that the results desired in a drilling fluid could be accomplished without fermentation of the gelatinized starch used for maintaining the vis-

cosity at such consistency as to convey the cuttings and also seal the bore hole by bringing the drilling fluid to a pH value of about 12 and maintaining it there during the course of the drilling. The specification of the prior application stated that any suitable alkali could be used for the purpose of adjusting and maintaining the pH value, and named caustic soda, caustic potash, caustic lithium, caustic ammonia and lime.

5. The prior application was involved in an action under R. S. 4915, this Court holding that the plaintiff, assignee also of that application, was not entitled to letters patent on the claims there involved for the reason that the claims defined no invention over the disclosure of the patent to Cannon 2,109,858, granted March 1, 1938, nor over the disclosure of the publication of Stern, Bulletin No. R. I. 3556, Bureau of Mines, Department of the Interior, dated February 1941. That decision was affirmed by the United States Court of Appeals for the District of Columbia Circuit. National Lead Co. v. Marzall, 93 USPQ 353.

6. The claims here in issue differ from the claims held unpatentable in the prior application only in the statement that an alkaline earth metal oxide is used to bring the pH value of the fluid to about 12 or to maintain the pH value at about 12 during the course of the drilling.

7. The patent to Cannon specifically names lime, an alkaline earth metal oxide, as the material for achieving high alkalinity in a drilling mud.

8. The publication of Stern discloses a hydrolyzed starch mud having a pH value of about 11 or 12, the starch being a pre-gelatinized starch added to the mud, which is then brought to the necessary pH value by any desired alkalinizing material capable of so doing.

9. Lime is the material now preferred by plaintiff for reaching and maintaining the desired pH value of about 12 for the drilling fluid.

10. The use of lime to reach the desired pH value of about 12 for the drilling fluid would be obvious to one skilled in the art, and therefore not invention.

11. The claimed subject matter is clearly non-inventive in view of the prior art.

12. Claims 11 to 15, inclusive, define no invention in view of the prior art.

13. Claims 11 to 15, inclusive, are unpatentable in view of the prior art.

Conclusions of Law.

1. Plaintiff is not entitled to a patent containing any of the claims (11 to 15 and 17) enumerated in the complaint.

2. The complaint should be dismissed as to all the claims.

Edward M. Curran,
Judge.

December 24, 1952.

JUDGMENT.

This action came on to be heard at the April term and thereupon upon consideration thereof, it is this 24th day of December, 1952,

Adjudged that the complaint be and it is hereby dismissed with costs against the plaintiff.

Edward M. Curran,
Judge.

NOTICE OF APPEAL TO THE UNITED STATES COURT OF APPEALS FOR THE DISTRICT OF COLUMBIA.

(Filed January 23, 1953.)

Notice is hereby given that National Lead Company, plaintiff above-named, hereby appeals to the United States Court of Appeals for the District of Columbia from the final judgment entered in this action on December 24, 1952.

DOCKET ENTRIES.

Date	
1951	
	Deposit for cost by.
Jan. 17	Complaint, appearance.
" 17	Summons, copies (1) and copies (1) of Complaint issued, serv. 1-18-51.
" 31	Answer of deft. to complt.; app. of E. L. Reynolds, Solicitor; mailed 1-30-51.
" 31	Calendared (N).
1952.	
June 18	Heard, argued & submitted; Reptd. by Howard B. Smith; Curran, J.
July 2	Transcript of proceedings of June 18, 1952 before Judge Curran; Reporter Howard B. Smith; pp. 1 thru 101, Vol. 1.
July 8	Stipulation of counsel re: time for filing briefs by pltf. & deft.
July 18	Correction to stipulation.
Aug. 21	Brief for deft.; mailed 8-20-52.

Sept. 8	Pltf's. reply brief; ser. adk. 9-8-52.
Nov. 26	Memorandum Opinion.
Dec. 9	Plaintiff's brief.
Dec. 24	Findings of fact & conclusions of law.
Dec. 24	Judgment dismissing complaint.
1953	
Jan. 23	Notice of appeal of pltf. (copy to E. L. Reynolds).
Jan. 23	Deposit by Richard G. Radue.
Jan. 23	Cost Bond on Appeal of pltf. in amt. of $250.00 with Fidelity & Deposit Co. as surety approved.
Feb. 7	Designation of Record, service ack. 2-6-53.

PRAECIPE.

Plaintiff's Designation of Record.

(1) Complaint.

(2) Answer to complaint.

(3) Opinion.

(4) Findings of fact.

(5) Conclusions of law.

(6) Judgment.

(7) Notice of appeal.

(8) Docket entries.

(9) Praecipe.

(10) Reporter's transcript of proceedings at trial, pages 26-97, beginning p. 26 "Harold H. Farnham" (omitting p. 77, lines 1 through 7, inclusive, from the bottom, and

p. 78, line 1), and ending with "Mr. Bruninga, that is all," p. 97.

(11) Deposition of Jack A. Beesley, appearing in Appeal No. 10,873, pages 82-90.

(12) Affidavit of John F. Dodge, appearing in Appeal No. 10,873, pages 149-154.

(13) Plaintiff's Exhibits Nos. 1, 2, 3A, 3, 4, 4A, 4B.

(14) Defendant's Exhibits 1A, 1B, 1C, 1D, 1E, 1F, 1G, 2 and 3.

Tr. 1

REPORTER'S TRANSCRIPT OF PROCEEDINGS AT TRIAL.

Washington, D. C.,
Wednesday, June 18, 1952.

The above-entitled matter came on for trial before Hon. Edward M. Curran at 10:00 o'clock a. m.

Appearances:

For the plaintiff:

John H. Bruninga, Esq.,
1004 Market St., St. Louis, Mo.

For the defendant:

Joseph Schimmel, Esq.,
Patent Office, Washington, D. C.

Tr. 26

HAROLD H. FARNHAM

was called as a witness by and on behalf of the plaintiff, and being first duly sworn was examined and testified as follows:

Direct Examination,

By Mr. Bruninga:

Q. Do you have a copy of the record in the other case? **A.** Yes.

Q. What is your name and where do you live? **A.** Harold H. Farnham, Houston, Texas.

Q. What is your business? **A.** I am assistant to the general manager of Baroid Sales Division, National Tr. 27 Lead Company. The Baroid Company manufactures and sells minerals and chemicals used in oil well drilling rod.

Q. Give briefly your education.

I have a degree of Bachelor of Science in chemical engineering from the California Institute of Technology. I graduated in 1924.

Q. What did you do after that? **A.** I worked five years for the General Petroleum Corporation of California as research engineer, gas engineer, in the refineries, gas plants and oil fields.

Q. Then you went to the Baroid Sales Division? **A.** In 1929 I was employed by a company that is now the Baroid Sales Division, as research chemist in Los Angeles. Since then I have held positions as division manager of the Gulf Coast, director of research, finally assistant to the general manager.

Q. When, if any time, did you become acquainted with oil well drilling? **A.** 1924.

Q. By what system? **A.** The rotary drilling system.

Q. Will you take Plaintiff's Exhibit 2 and, in view of my opening statement, give me very briefly an outline of that system? **A.** The hole is drilled by a bit that is Tr. 28 attached to what is known as the drill pipe. The drill pipe is a hollow pipe 4 to 6 inches in diameter, the last joint of which is square and is known as the "Kelly." The assembly is suspended in the derrick by a steel cable and is lowered away as the hole is made, only part of the weight of the assembly being allowed to rest on the bottom of the hole.

The pipe is rotated in order to cut the hole, by the rotary table shown on the floor of the rig. During this process the oil well drilling mud is pumped from a pit or tank through a rubber rotary hose down the hollow of the Kelly and the drill pipe. It issues from holes in the bit and flows upward through the hole that has been drilled, carrying with it the cuttings made while drilling the hole.

At certain intervals, casing will be placed in the hole as it is drilled. That is a separate operation from the actual cutting of the hole, each successive casing being smaller in diameter, and if the well is successful, and oil or gas sands are penetrated, the final casing is placed on the bottom of the hole, cemented in place, and the pipe and formation is perforated opposite the production horizon. Other pipe known as "tubing" is usually placed in the hole after that, and the well is washed in and allowed to produce.

Q. Now, the bit is larger in diameter than the drill pipe, isn't it? **A.** Yes, the bit will be as much as 24 inches in diameter, and the drill pipe is 4 to 6 inches. Tr. 29

Q. What kind of drilling fluid or mud was used in drilling when you started in 1929? **A.** A clay-water mixture, to which sometimes was added barytes to increase the weight of the mud.

Q. And this drilling fluid that you pump down is called by the drillers in the trade as drilling mud? **A.** Drilling mud is the common field term, yes.

Q. What is the purpose of that barytes, or weighting material? **A.** The purpose is to increase the weight of the drilling mud, for this reason: Whenever permeable horizons are penetrated, they will exert a pressure against the column of drilling mud equal to whatever formation pressure exists. The drilling mud will blow out unless it exerts a pressure against the horizon greater than that which is included in the curve there. The driller assures himself of successful operation and lack of blowouts by increasing the weight of the mud.

Q. Now, what is there about the consistency of the drilling mud as ordinarily used? **A.** It is about like heavy lubricating oil.

Q. Would you call that viscosity? **A.** Yes, viscosity is the term used for describing its consistency. It can be measured.

Tr. 30 **Q.** Is that viscosity important or unimportant in drilling? **A.** That is a very important characteristic and must be controlled within definite limits to assure successful operation.

Q. What happens if the viscosity is too high? **A.** The pumps will labor. You won't be able to circulate adequate mud. It will gas cut.

Q. Explain that. **A.** As you drill through gas-containing horizon, a certain amount of gas will be entrapped in the drilling fluid. Provided the viscosity and gel strength of the mud are controlled properly, the gas will escape on the surface. If the gel strength and viscosity are too high the gas will remain in the mud, reduce the weight of the mud and endanger the well of blowing out.

Q. Explain very briefly what you mean by gel strength. **A.** Drilling muds colloidal systems which, when permitted to stand quiet, will increase inconsistency with time; and conversely, when they are shaken or agitated, the viscosity will become lower. It is a system where the viscosity is a variable rather than a constant, as it is in water or in oil.

Tr. 31 **Q.** What happens to the cuttings if the viscosity is too high? **A.** They will remain in the mud and be recirculated, whereas it is hoped, or it is the intention of the driller, that the cuttings that are not removed by screens will settle out in the ditch or pit and won't be circulated.

Q. What happens if the viscosity is too low? **A.** Then the carrying power or transporting power of the mud will be too low to remove the bit cuttings from the bottom of the hole, and they will remain as a burden in the bottom and endanger the operation.

Q. What do you do (when) the drilling mud if the viscosity is too high? Do you just add water? **A.** You can add chemicals, such as caustic and quebracho or polyphosphate. And in certain systems lime will reduce the viscosity and gel of the mud.

Q. In other words, it will thin the mud? **A.** It will thin the mud, yes.

Q. What do you do if the viscosity is too low? **A.** Add alkaloids, such as starch, bentonite, or even reduce the rate at which you are adding mud centers, and permit the clay colloids to build up from the cuttings.

Q. What is bentonite? **A.** It is a highly colloidal clay found in the Black Hills region and is so sold widely in the oil fields.

Tr. 32 **Q.** What is quebracho? **A.** That is a crude tannic acid extract that is used for reducing the viscosity of drilling mud.

Q. I think you talked about caustic and quebracho. Why do you use caustic with that? **A.** The mixture of caustic soda and quebracho has long been used in the old fields as a thinner. The caustic is used in various ratios, and in some systems we want to increase the alkalinity of the mud to a pH of 12 or greater. In those instances we use substantially larger quantities of caustic.

Q. How long, to your knowledge, has caustic and quebracho been used to thin drilling fluid? **A.** I saw it first in 1930.

Q. Has it been used since? **A.** It has been used continuously in large quantities since then.

Q. And if the viscosity or thickness of drilling fluid is very high, do you add more or less caustic than if it is fairly thin?

Let me repeat that. How much caustic and quebracho do you add to a drilling mud, and under what conditions? **A.** It is used continuously. The rate of addition is judged by the driller or drilling mud engineer. Percentagewise for thinning you would probably have .2 to .5 of a percent of caustic and quebracho.

Q. The amount you use depends on how thick the mud is? **A.** It would depend upon the amount of clay Tr. 33 in the mud, the viscosity of the mud, and the degree of reduction that you wanted to obtain.

Q. If you cut down the viscosity by caustic and quebracho, can you then add more clay? **A.** Yes, you can add more clay to the system and maintain the original viscosity.

Q. And can you then add more caustic and quebracho and reduce the viscosity? **A.** Yes, but it is a diminishing return proposition. There is a limit to it.

Q. I wish you would give the Court an idea of the amount of mud or drilling fluid that is kept on the site at the well in barrels. **A.** In the order of 500 to 2,000 barrels of mud are usually held in the surface pit.

Q. You came into this business in 1929. Was there any science about the drilling of wells at that time? **A.** I think that is easily considered as an art, the skill required in actually drilling the well resting in the hands of men who have come up through the oil fields, first as laborers and rough necks and drillers.

Q. What is the situation today? Is it scientific, or is it a hit and miss proposition? **A.** In about 1930 the industry began to employ chemical engineers, petroleum engineers, men with technical training.

Tr. 34 **Q.** Does your company employ engineers? **A.** Yes, we have service engineers covering the entire oil country of the United States and some foreign fields.

Q. How many do you have, about? **A.** There are at least 250.

Q. Do those salesmen sell the materials to the consumer? **A.** No, they service it, and act as consultants for the drilling contractors and companies, prescribe the type of mud to use and the treatment to maintain it.

Q. Who are your materials sold to? **A.** The materials are sold to distributing companies in the oil fields.

Q. Your company has a number of patents, has it not? A. Yes.

Q. What has been the policy of your company, to hold the patents for itself or to permit others to use them? A. No, we don't drill an oil well. We permit others to practice our well mud patents.

Q. Has it been the practice of your company to license others under your patents? A. Yes, we have licensed many companies under our patents.

Q. On a royalty basis? A. On a royalty basis.

Tr. 35 Q. Do those licenses try to restrict them in any particular materials? A. No, they are under restrictions as to source.

Q. Coming down to viscosity, how do you measure viscosity, and what kind of instruments do you use? A. It is measured by observing the rate of flow of mud through a funnel in the field. The more time required indicates the greater viscosity.

Q. That is a funnel? A. Yes. There is a more accurate one used in the laboratory, where we use the force required to rotate a spindle at a constant speed, suspended in the mud. That is known as the Stormer method.

Q. The first one, the funnel, measures it in seconds? A. That's right. And the second one, the Stormer, records the viscosity in centipoises.

Q. That is usually abbreviated CPE? A. That is correct.

Q. How do you measure gel strength? A. That is also on a Stormer, by putting the spindle in the mud and allowing it to remain quiet an instant, then measure the force required for initial movements. That is reported as zero times gel strength. Then we repeat, allowing the mud to remain quiet for ten minutes, and again measure the force required to rupture the contact between the mud and the spindle. That is referred to as the ten minute gel strength. Both are measured in grams. Tr. 36

Q. Suppose that drilling is interrupted at any time, does that ever happen, that drilling is interrupted? **A.** Yes, it is always interrupted when about 30 feet of hole is made and it is necessary to put another length of drill pipe in the string, or when the bit becomes dull and the entire string has to be pulled out and the bit replaced and lowered away.

Q. What happens if proper precaution has not been taken? **A.** If the mud is in poor condition, all the cuttings will settle to the bottom, or if it is at all gas-cut, it may start to effervesce and blow out.

Q. What are the functions of the drilling fluid that are performed in carrying the cuttings out of the hole? **A.** It must act as a lubricant to the bit as it is cutting the formation, and carry up the cuttings. It must also offer more pressure against the formation than that contained in the permeable formation. It must lay down a pipe, impermeable mud sheath, so that the mud itself is not lost in the permeable formation.

Q. How is that carried out, laying down the sheath? **A.** It is carried out by a filtration process. The pressure in the drilled hole being greater than that in the formation will cause a flow from the hole into the permeable formation. The solids contained in the mud will be filtered
Tr. 37 out, the water in the mud will pass through. If the
proper solids are chosen for the drilling mud, the flow will cease when a very thin impermeable take is laid down.

Q. What is that called, that flow of water to the system? **A.** Filtration.

Q. How about water loss? **A.** In the laboratory and field tests it is referred to as water loss and is measured in a standard type of test equipment recognized by the American Petroleum Institute.

Q. That is carried on outside of the well by taking the drilling fluid and find out how much the filtrate will be?

Is that right? **A.** That is one of the major tests conducted in the field for evaluating the mud.

Q. What is that expressed in, the water loss, API? **A.** Water loss is expressed in cc's of filtrate during the period of the test, which is 30 minutes.

Q. You mean cubic centimeters? **A.** Yes, cc's are cubic centimeters.

Q. What is the water loss that ordinary clay will give? **A.** Ordinary clay mud will have a water loss ranging from 10 to 30 cc. If they are contaminated with certain faults or electrolytes, they may have as great as 100 cc. water loss.

Tr. 38 **Q.** How about bentonite? **A.** Bentonite and water will have a water loss of 9 to 10 cc.

Q. In what kind of water? **A.** Distilled water.

Q. Suppose you are drilling and you hit salt water, what happens to the bentonite? **A.** It will be flocculated and the water loss will rise rapidly.

Q. Suppose that happens opposite a producing formation, what effect does that have on the producing formation? **A.** An excessive amount of water, leading the mud into a gas or oil formation, will push the hydrocarbon back, and in many cases has actually prevented the production, the later production of those wells.

Q. Is there demand among the contractors to keep that water loss down? **A.** Yes, in many cases the maximum water loss permissible is specified by the oil company.

Q. How about starch? **A.** Starch is used to effect the water loss even lower than bentonite will give.

Q. In what form? **A.** Pre-gelatinized starch.

Tr. 39 **Q.** Does it form a jelly in that case? **A.** Yes. It is added to the drilling mud and results in an increased viscosity, an increased gel content, and the resulting mud has a much lower water loss.

Q. Is ordinary starch active? Can you use ordinary corn starch in the well, raw starch? **A.** No, raw corn starch will not form a gel.

Q. Would it be any good in the well? **A.** It is of no value unless it is gelatinized.

Q. Have you read this application in this suit, Plaintiff's Exhibit 1? **A.** Yes.

Q. The application in this suit? **A.** Yes.

Q. Do you have a typewritten copy of it? **A.** Yes.

Q. Who were Sikes and Beesley in that application? **A.** In 1941 Dee A. Sykes was division manager of the Mid-Continent Division of our company, and Jack Beesley was a salesman working in the Illinois oil field.

Q. You mean selling your materials? **A.** Servicing our materials in the oil field.

Q. In Illinois? **A.** In Illinois, yes.

Q. Do you know the history of that particular pH system? **A.** Yes, I do.

Tr. 40 **Q.** This particular application here specifies the use of lime to maintain high alkalinity or high pH. Did you become familiar with that? **A.** I learned about it from Sykes late in 1942 or early in 1943. That was the general pH system using caustic soda. I did not learn about the lime addition until late in 1944 or early in 1945.

Q. What was the position with respect to lime? **A.** As far as we were concerned on the Gulf Coast, we were fearful of using lime in any form in drilling mud.

Q. Why? **A.** We knew that it would flocculate the clays in the drilling mud, cause great increases in viscosity, cause great increases in the water loss. In fact, one of our main problems in treating clay mud is the guarding against and removal of calcium contamination.

Q. Going back just a little bit, if you use starch in the well, gelatinized starch, and do nothing more, what happens? **A.** The starch will ferment unless the yeast enzymes are killed in one fashion or another. You can prevent the fermentation in a high pH system, that is, alkalinity greater than about 11, or in a system where the salt concentration is substantially greater than 15 percent, by the addition of certain poisons, such as paraformaldehyde.

Tr. 41 **Q.** Now, I think you said you were afraid to use lime in that system, in that starch system. Is that right? **A.** Yes, I was afraid to use lime in any system, any drilling mud system.

Q. You had to sell the drilling people on that idea, didn't you? **A.** Yes. Up to 1945 the drilling industry in the Gulf Coast was most fearful of the addition of lime or calcium compounds in any form to their drilling mud.

By the Court:

Q. You have been with this company how long? **A.** Since 1929.

Q. And you testified in that other case?[*] **A.** I was here in June, 1950.

Mr. Bruninga: He testified in that case.

By the Court:

Q. You testified in that case, did you? **A.** Yes, sir.

Q. Did you have anything to do with the preparation of the claim here? **A.** No, sir.

Q. Did you discuss it with anybody at all? **A.** I don't know. I didn't discuss it with the claimant.

Q. Was the invention in the other case discussed Tr. 42 with you at all? **A.** Yes, it was.

Q. And you are familiar with the statement in the other case that even lime is employed. Talking about the drilling fluid, this application DX 2 says, page 8:

> "The drilling fluid may be brought to the desired pH by any suitable alkali, as by the addition of caustic soda, caustic potash, caustic lithium, caustic ammonia, etc. Of these, caustic soda is the most economical to employ. However, even lime may be employed, particularly as soda lime."

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[*] Appeal No. 10,873, this court.

This was filed June 7, 1943, at the time when you said you were afraid to use lime in this connection, but the application says that even lime is employed, although it is not as effective as caustic soda.

A. Yes, that was not my opinion in 1943.

Q. It was not? **A.** Not in 1943.

Q. But this was filed in 1943, and it says lime may be used. **A.** I didn't see that until——

Q. Wait a minute. You were with this company since 1929? **A.** Yes, sir.

Q. When these claims were being prepared, wasn't the matter of this invention discussed with you? **A.** Only in the broadest sense. I knew that one was being prepared. Tr. 43

Q. They depended on your testimony to obtain invention, didn't they? **A.** No, I don't think so.

Q. Well, there were only two witnesses in the last trial, weren't there? **A.** Yes, in 1950. The art is this—I may not understand——

Q. Your testimony is that under no conditions would you use lime; you were afraid of it, prior to 1944? **A.** That is correct.

Q. Yet in 1943 your company filed a petition in which it says that lime is employed. **A.** I don't think I saw that until 1947 or 1948.

Q. You didn't see that until 1948, this application for patent? **A.** Yes, about 1948, I think.

Q. You didn't see it before it was filed? **A.** No.

Q. And they didn't discuss it with you as an employee of the company, the effect that lime might have in bringing the desired pH to suitable alkalinity? It was not discussed with you by the plaintiff? **A.** No. I wish to interject this, that from 1942, December of 1942, till March, 1944, I was absent from the company. I was in the Navy. I believe it was the latter part of 1944 before I discussed anything about the preparation Tr. 44

of the high pH patent application. Late in 1942 I knew that caustic soda was used to create a high pH system. Sikes told me that.

Q. Is it true that lime is not as effective as caustic soda, and its tendency is one to flocculate the drilling fluid before starch is added? A. It is not as effective in——

Q. Read this paragraph here (indicating DX-2, page 8). A. I would say that was substantially correct. Might I question "the most economical to employ"?

Q. Very well.

By Mr. Bruninga:

Q. Which will give you the highest pH or alkalinity, caustic soda or lime? A. Caustic soda will.

Q. How high do you have to go in order to avoid fermentation? A. It should stop fermentation at about 11 pH.

Q. How high will lime carry the pH? A. About 12½.

Q. Is it necessary to carry it any higher? A. No, it is not.

Tr. 45 Q. As far as the matter of lime flocculating the drilling fluid, the statement is: "Lime is not as effective as caustic soda, and its tendency is one moreover to flocculate the drilling fluid before starch is added." A. That is correct. Lime will flocculate the clay in the drilling fluid, wholly flocculate it.

Q. Suppose you bring a drilling fluid to the pH of 12.6 or 12.4 with lime, you begin to flocculate the clay? Is that right? A. Yes, it will.

Q. Suppose you then add starch? A. Then you will reduce the viscosities and gel strengths that have been caused by flocculation of the clay, and greatly reduce the water loss that has been increased through the addition of calcium hydroxide.

Q. Now, in the art—I will bring that in a little bit—you said they didn't like to use lime. A. That's right.

Q. In drilling? A. That's right.

Q. They were afraid of it? **A.** That's right.

Q. What did they consider the effect to be? **A.** It was very harmful material to get into the mud—
Tr. 46 ruin it.

Q. That is what they thought? **A.** Yes. They thought it would ruin the mud.

Q. Had you heard of anybody adding lime to drilling fluid and then adding starch, before you heard about this Sikes-Beesley proposition? **A.** I didn't get that.

Q. Did you hear of anybody using lime in a drilling fluid and then adding starch before the Sikes and Beesley proposition? **A.** No.

Q. Do you happen to know who Preston E. Chaney is? **A.** He is a prominent engineer employed by the Sun Oil Company in Beaumont, Texas.

Q. Is he an educated or an uneducated man? **A.** He is a registered engineer and well accepted by the industry, by the profession.

Q. I have an article written by Mr. Chaney in the Oil Weekly of November 23, 1942, entitled "A Review of Recent Advances in Drilling Mud Control." Are you familiar with that article? **A.** Yes.

Mr. Bruninga: I want to mark this and offer it in evidence as Plaintiff's Exhibit 3-A.

Mr. Schimmel: No objection.

Tr. 47 (The document referred to was marked Plaintiff's Exhibit No. 3-A and received in evidence.)

By Mr. Bruninga:

Q. On page 28 Mr. Chaney says this is in the right-hand column:

> "One of the most common mud troubles is cement contamination. Usually no symptoms are required to locate this trouble, because it may be expected whenever operations require that cement be drilled, and particularly when the cement has not set thoroughly.

> "Effect of cement on clay colloids. Calcium hydroxide (slaked lime) is present in cement slurries, largely as a result of the hydrolysis of various alkaline calcium silicates and aluminates. The calcium hydroxide so formed is responsible for the observed changes in the mud properties. The calcium ion replaces the sodium on the clay particles, thus converting them to calcium bentonite, while the hydroxyl ion produces a sharp increase in mud pH. As discussed previously, the calcium clays are not so highly ionized as the sodium clays. Consequently, the degree of hydration and dispersion of the clay colloids is reduced. This accounts for the increase in water loss resulting from cement contamination. A further effect of the calcium ion is a flocculation of the clay colloids; that is, Tr. 48 the colloid particles are caused to combine into aggregates of much larger size. Flocculation is responsible for the high viscosity and gel rate of cement muds. The increase in pH, due to the hydroxyl ion coming from the slaked lime tends to increase further the gel strength of the mud, and thus adds to the trouble."

That was in 1942, before even the first application DX 2 was filed. Can you tell me whether that was the attitude of the art as regards calcium oxide, that hydroxide would form as the main constituent of cement? **A.** Yes. Mr. Chaney is there describing the effect of calcium contamination as a result of the inclusion of cement in drilling mud.

Q. What precaution was taken when you got cement in the drilling mud, in the past? **A.** Either impregnating the drilling mud with sodium bicarbonate to precipitate out the calcium, or subsequently treat it with phosphate, polyphosphate, sometimes caustic and quebracho.

Mr. Bruninga: Your Honor will want to take this case down, because it involves that very question and the troubles encountered in the use of calcium oxide or hydroxide, particularly when cement is encountered, in re: Jones, 120

F. 2nd 1018, Court of Customs and Patent Appeals. That is about as neat a thing to read on this whole atti-
Tr. 49 tude of the art at that time as you can find.

By Mr. Bruninga:

Q. Now, when you add lime, how does that lime really act on that clay that has been flocculated? **A.** The addition of lime to a clay water drilling mud will immediately cause an increase in viscosity, gel strength and water loss. The more colloidal the base change is, the greater those changes will be.

Q. This application that we have here before the Court was filed February 25, 1946, and, of course, we have one year to file that application before it went into public use, whether the preceding one of 1943 or not.

Now, take the situation in 1946. Were you back from the Navy by that time? **A.** Yes, I returned in May, 1944.

Q. As I understand it, and as appears in the case before the Court of Appeals, at least before 1945 your company advocated the use of sodium hydroxide, caustic soda with lime, to get your pH? **A.** Yes.

Q. Then when you came back from the Navy—you were gone, I understand, from 1942, over that period, although I suppose you talked with the boys about what was going on. Is that right? **A.** Occasionally, yes.

Tr. 50 **Q.** You were located right there in Texas, weren't you? **A.** That's right.

Q. With the Navy. When you came back, what happened, as far as the lime-starch procedure is concerned? **A.** As I remember the date, in 1945 the recommendations were being made in the field to use calcium hydroxide rather than sodium hydroxide to create and maintain the high pH. That was based—or rather, was subsequent to information coming to the Gulf Coast from the Mid-Continent Division as to the success they had had with such a treatment.

Q. Are you familiar with what has been happening in the oil fields of the United states for the last 10 or 15 years, outside of the time that you were in the Navy? **A.** Yes, I am.

Q. Do you know what is happening now? **A.** I am in touch with the drilling end of the industry, yes.

Q. In what way does your job require that? Do you have anybody under you? **A.** Yes, I have several service laboratories that are stationed in the three principal oil districts, research groups in Houston, and a well logging service consisting of some 350 employees that work in the various drilling or the various active oil fields.

Tr. 51 **Q.** Do you know what year the lime-starch system went into use? **A.** As far as my observation goes on the Gulf Coast, it was used early in 1945.

Q. And up to that time your company was recommending caustic soda? **A.** As far as the Gulf Coast went, yes.

Q. And after that was it tried out in the wells in 1945? **A.** Yes, that was the date, as I recall, the first date in the Gulf Coast division where lime was intentionally added to the clay base, starch drilling mud, and it resulted in a great reduction in expense required for maintaining the mud.

Q. Where was that well drilled? Do you remember? **A.** There were two about the same time, one in Brazoria County to the south of Houston, and there was another one, a Phillips well in an East Texas county, I don't remember the name.

Q. How did it work? When they added lime to get a pH of about 12, and then added starch what happened? **A.** We could maintain the high pH with lime as well as they had formerly done with caustic; we could greatly reduce the viscosity-contributing effect of clay colloids that were drilled up during the course of drilling. That greatly reduced the amount of maintenance materials that had to be purchased to hold the drilling mud at constant condition.

Tr. 52 **Q.** That was in 1945, about seven years ago. What has happened since that time?

Comparing the two systems now as you have observed them being used in the field, and as you get reports, what are the relative percentages of the caustic starch and the lime starch systems that are used today? How are they divided, in what proportion? **A.** I would say that in the wells using high pH starch systems, at least 80 percent of them employ calcium hydroxide, and less than 20 percent of them employ sodium hydroxide to maintain that high pH.

Q. Did you have difficulty in getting people to use the lime-starch system? **A.** We did at first, yes, but once we achieved success with it and could talk about that, we applied it to similar wells.

Q. Caustic soda is just plain lye, isn't it? **A.** Yes, sodium hydroxide.

Q. Is it very nice to handle? **A.** No, it is a most caustic material.

Q. What happens if you get it on your hands? **A.** It will destroy your skin.

Q. What precautions were taken with it, with the men around the rigs when they used the caustic starch system? **A.** The men that mixed up caustics had to wear Tr. 53 rubber gloves and goggles and exercise all manner of precautions. The caustic soda is delivered to the field in dry plate form, in drums, and it was rather common to see the men with their clothes chewed up, or the results of burns on their hands or legs.

Q. On a rig does the drilling fluid splash around at all? **A.** Yes, it is all an outside performance.

Q. How do you have to contain that? What kind of containers do you have to put caustic soda in? **A.** Caustic soda is delivered in the field in steel drums, and then it is shoveled from that into an open drum, mixed with water and quebracho. The resulting solution is dumped into the drilling mud circulating system.

Q. The caustic soda starch system will work, will it not? **A.** Yes.

Q. It was working for a long time? **A.** Yes.

Q. And did it stop fermentation? **A.** Yes, whenever the pH was held substantially around 12.

The Court: Suppose it was around 11?

The Witness: At my place, where it will begin to ferment——

The Court: Where is that place?

Tr. 54 The Witness: It depends a lot on the location and the type of clay, the type of salts that are in there. I have heard of some as low as 10½ that did not ferment. I have heard of others that were a little bit below 11 that did ferment.

Mr. Bruninga: I want to offer in evidence as Plaintiff's Exhibit 3, two pages from the Handbook of Dangerous Materials, title page and page 350, sodium hydroxide and caustic soda. Is that right?

The Witness: I didn't hear that.

Q. I say sodium hydroxide is caustic soda? **A.** Yes.

Q. This just explains the caustic properties of sodium hydroxide or caustic soda. Care has to be taken. As compared with that, let us take up lime, hydrated lime, calcium hydroxide. Have you handled that? **A.** Yes, that is used now in the oil fields to maintain the high pH starch system. It is delivered in paper bags.

Q. Can you handle it with your hands? **A.** You can do it without too great risk, yes. It is only about 1/50th to 1/70th as caustic as dry caustic soda.

Q. Now, compare the action of caustic soda and lime— the caustic soda-starch system with the lime-starch system.

Let me start over again. Compare these two systems, namely, the caustic soda-starch system and the lime-starch system, in each case having gelatinized starch. Is

Tr. 55 there any difference in action between those two on the clay that is used in the drilling fluid? **A.**

Yes, there is an entirely different action of those two alkaline materials on the clay.

Q. In what way, if you can briefly explain? **A.** The clay minerals have attached to them what is known as exchangeable bases, that is, one alkaline element can be replaced by another one under certain conditions. The clays that are chosen for drilling mud use, and those shales that are penetrated in the Gulf Coast, have very high mud-making ability, due to the predominance of sodium attached to the clay minerals. When that clay mineral is not attached, it has little or no mud-making ability.

In the caustic soda-starch system, as the shales are incorporated in the drilling mud during the progress of drilling, their ability to make mud is reduced quite a bit by the presence of the caustic and the quebracho. The mud-making ability is depressed, I would say.

In a system where calcium hydroxide takes the place of sodium hydroxide, we have altered the nature of the clay mineral by generating a calcium bentonite or a calcium clay, which mineral has little or no tendency to swell in water. We can therefore crowd in a higher percentage of shale cuttings in the calcium system than we can in the sodium system. That, translated into the cost of
Tr. 56 maintenance of the drilling mud in a well means
a great reduction in the purchase of such items as starch, weighting material, treating agents, and all of the many things that are bought to add to the mud. Both systems at pH 12 equally prevent fermentation of the starch.

Q. I hand you a three-page paper marked Plaintiff's Exhibit No. 4. Are you familiar with that? **A.** Yes.

Q. These tests that were carried out, where were they carried out? **A.** They were carried out in our laboratory in Houston, Texas.

Q. Under whose supervision were they carried out? **A.** They were done under my general supervision, and for the purpose of showing the difference in the clay-starch-alkali system, depending upon whether caustic soda or lime was chosen as the alkalizing agent.

Q. Proceed to discuss what was done. **A.** We made up a mixture of 10 percent clay, 90 percent water, choosing a clay that is similar to the shales penetrated in drilling. That was alkalized to a pH of 12.1 in the A series with lime, and in the B series with caustic soda.

Q. You are referring to Table 1 on the second page? **A.** Yes, I am referring to Table 1 and the columns labeled "A" and "B," "A" denoting the ones that were
Tr. 57 treated with lime, and "B" the ones treated with caustic soda.

After agitation there was added various quantities of starch to each series, the amount of starch being indicated at the top of the fourth column. Then the muds were heated, aged overnight, and their properties measured.

Turning to Table 1, the first thing I would like to call attention to is the difference in the action of the two alkalies on the clay itself. When lime is used to increase the pH to 12.1, the viscosity of the mud is increased to 19 centipoises. When caustic soda is used, it is increased to 92 centipoises.

The difference between the two is also illustrated by the filter loss of the resulting alkalized mud, 152 cc being lost from the "A" unit, the one that was lime-treated, and only 11 cc from the caustic soda-treated mud. That is indicative of most, if not all, of the clay colloids in the "A" column that have been deflocculated, due to the substitution of the calcium for the clay mineral.

The next group has 4 pounds per barrel of gelatinized starch in both "A" and "B." Note that the viscosities of both have been reduced, in the lime-treated one from 19 to 3.2; in the caustic soda one, from 92 to 59.

The initial 10 min. gels have been reduced, but the lime ones to zero, zero.

The filter losses have been reduced, the lime one
Tr. 58 from 152 to 7.5, the caustic one from 11.1 to 5.3.

The next two columns indicate 8 and 12 pounds, respectively, of starch added to the same type of mud. In that region the water loss or filter loss of the lime-treated mud is lower than that of the caustic one. However, the gels are still zero zero on the following lime treatment, whereas the gels of the samples containing the caustic soda are increasing very rapidly, as is also the viscosity.

The lime-treated samples can have added to them substantial quantities of more clay of this same nature before being changed to characteristics similar to those in the "B" column, that is, the higher viscosity and the higher gels, which means in oil drilling practice that the "A" mud could have included a much greater burden of shale cuttings before you would have to have recourse to dilution of the mud or the purchase of mud materials to maintain the mud characteristics.

That is the same as we found in the field following the substitution of lime for caustic, a great reduction in the purchases required to maintain constant characteristics.

Mr. Bruninga: Will Your Honor permit me to mark these jars Exhibits 4-A and 4-B? They are related exhibits.

(The two jars referred to were marked Plaintiff's Exhibits 4-A and 4-B.)

Q. I hand you two jars marked Plaintiff's Exhibits
Tr. 59 4-A and 4-B. What are they? **A.** 4-A is a jar
containing 10 percent by weight of the same clay used in samples described under Table 1, 90 percent water, to which has been added 8 pounds per barrel of starch and 1.9 pounds per barrel of caustic soda. This is a mud of 103 viscosity and 115 gel, a pH of 12.1, and a filter loss of 4.3.

Exhibit 4-B is the same base mud, containing 8 pounds per barrel of starch and 3.5 pounds per barrel of calcium hydroxide. It has a viscosity of 7.0, a gel of zero zero, a pH of 12.1, and a filter loss of 2.2 cc.

The Court: What is that, lime?

The Witness: Yes, Your Honor, this (PX 4-B) is the lime added to the clay starch, and this (PX 4-B) contains caustic soda, both being at the same pH.

By Mr. Bruninga:

Q. How about the viscosity of the one containing caustic soda? **A.** The one containing soda, viscosity 103, is entirely too thick to use as a drilling mud.

Q. You can, however, thin it down with thinner, can't you—only with water? **A.** To thin it with water would require dilution, I would imagine, of at least 100 percent. It could be thinned temporarily with quebracho.

The one containing lime is very fluid. In fact, it Tr. 60 might be a little too fluid to use in most cases.

I would restore that viscosity with additional clay and more starch.

Q. And the more starch you add, the lower the water loss? **A.** Yes. If more starch were added, the filter loss would drop below this 3.2.

Q. I don't think those are the exact drilling fluids that were given in Table 1, but I take it were prepared as close to those as could be done? **A.** I would say they were within the experimental error of duplicate samples 103 versus 140 viscosity.

Q. In carrying out this experiment shown in PX 4, while you used up the mud in doing what you did, it was to prepare and retest another mud to use in court? **A.** Yes.

Q. Do those compare with the drilling fluids and muds containing 8 pounds of starch? **A.** I would say that was a very good comparison between the figures shown in these two exhibits and the figures or characteristics shown under the 8 pounds per barrel starch; that is, the differences are within the experimental error of making up fresh batches of mud and treating with specified amounts of starch and alkali.

Q. When you thin the one at 4-A down with water, what happens to the weight of the drilling mud? A. It will be reduced accordingly.

Tr. 61 Q. The one with caustic? A. 4-A is the one containing caustic soda. If that viscosity were reduced from 103 to a workable viscosity, the weight would drop in proportion to the amount of water added.

Q. And can that be tolerated in places where you are liable to encounter gas pressure? A. If it is done, you will have to purchase an equivalent amount of weight material and restore the desired weight in the mud.

Q. But now, take the one 4-B, where you have the viscosity of about 7, I think it was, and you can add weight material to that, can't you? A. Yes, that mud is capable of containing weight material or added clay before the viscosity requirements are exceeded.

Q. I wish you would take page 3 of that Exhibit 4 and explain that to the Judge, because that is a visual indication of what happens in this test. A. These are two charts which merely plot the data on Table 1, that is, we can follow the effect of adding starch in quantities up to 12 points per barrel to the two clay water systems, the one alkalized by lime, shown on the bottom in a solid line, and the other alkalized by caustic soda shown in the dotted line. Without the addition of any starch, the effect of the two alkalies is shown by the point Tr. 62 where the two types of limes intersect, the viscosity of the clay lime system being shown on the order of 20, and of the clay caustic system being approximately 95. You can see that the addition of starch initially reduces the viscosity of both systems. It continues that way until concentration of about 4 pounds per barrel of starch is achieved; then the addition of further starch rapidly increases the viscosity of the system that was alkalized with caustic soda.

It slowly increases the viscosity of the system alkalized with lime, as shown by the solid line at the bottom.

You will notice that the gel strength, 10 min. gel strength, follows essentially the same paths.

The bottom part of the page shows the characteristics of filter loss from the two types of treatment.

Q. That is water loss? **A.** Water loss, yes. This is the amount of water that is capable of being squeezed from the drilling mud at 100 pounds pressure in this 3-inch filter, as specified by the API. Without any starch present, the clay-water mixture that was alkalized with caustic soda loses only about 11 cc; the one that was alkalized with lime was so high that it cannot be shown on here, and the checks indicated a 152 cc loss. Both those water losses are reduced by the addition of starch, so by the time 4 pounds per barrel of starch is in there, the
Tr. 63 water loss of the lime-treated one is on the order of 7½; of the caustic one, about 5½. But at about a concentration of 6 pounds per barrel of starch, these two curves reverse, and when they get as high as 12 pounds per barrel of starch, the system containing lime has a water loss of about 2 cc, and the one containing caustic soda about 3 cc.

Q. As far as water loss is concerned, the effect of the caustic-starch system and the lime-starch system is generally the same, as far as obtaining water loss? Is that right? You get some water loss with the lime system, don't you, but it is not outstanding, is it, so far as water loss is concerned?

The Court: I shouldn't think you got that. I didn't.

The Witness: I got "loss" in the question.

The Court: All right.

By Mr. Bruninga:

Q. I will try it over. As far as water loss is concerned, as shown on the third page in the diagram, which is the most effective, the lime-starch system or the caustic-starch system? **A.** The most effective, as far as water loss is concerned in the low range is the caustic one; in the high range of treatment, or the lower water loss one, the lime is.

Q. When you go to water loss below 5, which is Tr. 64 the most effective? **A.** There is a little advantage to the lime treatment when you want to achieve water losses in the range of 1 or 2 cc.

The Court: Does that make any difference, 1 or 2 cc?

The Witness: In some cases it does, yes, Your Honor. In some places we wish to prevent any water at all from getting there.

The Court: You can't do that, can you?

The Witness: You have to use an oil base mud. You have to go to a different system.

The Court: Why don't you use the other system?

The Witness: There are certain patents that keep us from using that.

The Court: Of the materials that you can use, that you are allowed to use, that are not patented, there will be some water loss?

The Witness: That's right. There will be some water squeezed out with any starch mud.

Mr. Bruninga: How about the cost of the oil system?

The Court: He can't use the oil system, he said.

By Mr. Bruninga:

Q. Let us suppose we can use it, how about the cost? **A.** The oil base mud system is somewhat more expensive than this.

Tr. 65 **Q.** Is there a fire hazard? **A.** Yes, there is a fire hazard in oil drilling with the oil system.

Q. What do they use for oil? **A.** They use crude oil or Diesel fuel oil.

Q. Coming back to comparison of the cost of the starch system and the lime-starch system, Plaintiff's Exhibit 4, third page, is there an advantage in having a low viscosity rather than having the viscosity run up high? **A.** The advantage of the low viscosity is that more shale solids can be included in the mud before you have to dilute the mud and build its weight up again.

Q. How about the capability of control at the well? **A.** It is much easier to control, to maintain constant the lower viscosity muds than the higher viscosity muds.

Q. Do the two systems indicated on those diagrams indicate a mere difference of degree between the two? **A.** I would say there is an entirely different order of viscosity and gel characteristics between the system that is treated with caustic soda, and the system that is treated with lime.

Q. Is there a difference in principle of operation of the two systems? **A.** Yes, the principle of operation stems directly from the type of base that is attached to the clay mineral. In the one case it is the sodium clay, Tr. 66 and in the other it is the calcium clay. They act entirely different in water systems.

Q. Now, you get the same kind of clay in your drilling? In the two systems you come down to the same kind of clay? **A.** You are drilling through it.

Q. In taking the two systems, you apply the caustic starch to the drilling fluid or apply a lime starch to the drilling fluid. Is the resultant clay content of the two drilling fluids the same or are they different? **A.** They will be different. You will be drilling through a clay that is predominantly a sodium clay. If it is incorporated in the system that is alkalized with caustic soda, it will remain a sodium clay. If it is incorporated in the one that is alkalized with calcium hydroxide, it will be changed to a calcium type of clay.

Q. How about the difference in cost between caustic soda and lime? **A.** I think caustic soda is four to six times as expensive as lime.

Q. If caustic soda is exposed to the atmosphere, what happens to it? **A.** It absorbs moisture.

The Court: Caustic soda is more expensive?

The Witness: Yes, it costs about four cents, and lime costs about one cent, I think.

Tr. 67 The Court: This application (DX 2) was filed in 1943, and you people said then that caustic soda was the most economical to employ. When did you change your mind?

We will take our recess at this time until 1:45. We are devoting too much time to matters in this case that I already have in mind. I think you ought to start cross-examination. You are taking up too much time. There is only one issue in this case.

Mr. Bruninga: I am coming right to that.

(Thereupon, at 12:00 o'clock noon, a recess was taken until 1:45 p. m. this day.)

After Recess—1:45 P. M.

The Court: All right, gentlemen.

Thereupon—

HAROLD H. FARNHAM,

the witness on the stand at the time of recess, resumed the stand and testified further as follows:

Direct Examination (continued).

By Mr. Bruninga:

Q. If you will turn to DX 2, page 8, which is part of the application, filed in 1943, the statement in the middle paragraph:

> "The drilling fluid may be brought to the desired pH by any suitable alkali, as by the addition of caustic soda, caustic potash, caustic lithium, caustic ammonia, etc. Of these, caustic soda is the most economical to employ." Tr. 68

How about the cost of caustic potash, caustic lithium and caustic ammonia? What is their cost, compared with the cost of caustic soda? **A.** They are all more expensive than caustic soda, I think in this order: Lithium is certainly the highest, potash next, then ammonia, and then caustic soda.

Q. And of those four, the caustic soda is the most economical to employ? **A.** Yes, of those four.

Q. Have you changed your mind on that? **A.** No, those are still the price ranges.

Q. Taking up the Stern publication, Defendant's Exhibit 1B, do you know what he describes in that second paragraph on page 77? **A.** Yes, I know of the Stern article, which he was talking about.

Q. What does he describe there in that second paragraph? **A.** He is describing the method of cooking up or hydrolizing raw starch in a tank in the oil field, and dumping the gelatinized starch into the drilling system.
Tr. 69 That drilling system contains salt.

Q. And where is that stated? Is that in the same paragraph, the first paragraph, or the second paragraph—dumping into the drilling mixture? **A.** The second paragraph on page 77 describes the method of cooking up the starch in an alkaline solution, and then the third paragraph discusses the protection of the starch-laden mud from bacterial action, provided there is, as he says, 10 percent salt in the mud.

Q. In your opinion, what does that statement: "A pH of about 11 or 12 has been found desirable"? **A.** That is the desirable pH to hold the system as it is being cooked.

Mr. Schimmel: Your Honor, I thought the previous decision of the Court of Appeals, which is what these references disclose, was conclusive, and this witness' opinion is immaterial.

The Court: That is right.

By Mr. Bruninga:

Q. Does Stern refer to use of lime at all? **A.** I see no reference to it in here.

Q. Take up the next, the Cannon patent, Defendant's
Exhibit 1A, what does that disclose? A. This is a process
of preventing shale from heaving into the hole, a means of
preparing a highly alkaline drilling fluid from, as
Tr. 70 shown by him, caustic and quebracho in large per-
centages, and adding a plasticizer, bentonite, to
that drilling fluid.

Q. What function does caustic quebracho perform? A. As a drilling mud thinner.

Q. What happens as the caustic and quebracho get together? A. There is a solution of sodium tannate formed.

Q. What percentage of bentonite is used? A. His examples are from 10 to 30 percent bentonite in the drilling mud.

Q. Does he give any example at all of the use of starch with caustic, except the statement on page 2, line 3, in which he mentions starch? A. No. His two examples, column 2, page 2, are caustic soda and quebracho extract as his mud thinner, and bentonite as his plasticizer.

Q. You refer to the use of caustic and quebracho in 1930. It was used as a thinner? Is that right? A. As a mud thinner.

Q. Is tannate used as a thinner? A. Yes, he so states.

Q. Does he so state? A. Yes.

Q. Do you know what that mud was called in the art?
A. Cannon's invention was referred to as the
Tr. 71 Humble red mud, the Humble Company being his
employer. They were the first to use it, and other
companies used it occasionally for some eight or ten years.

Q. Does Cannon describe in his patent gelatinized starch? A. No, he says starch. He makes no mention of gelatinized starch.

The Court: Is starch a substitute for quebracho? In other words, does it perform the same function, substantially in the same way, and secure the same results when added to the mud?

Mr. Schimmel: I think we are passing something that is important. Look at page 4 of the Court's decision. It says what Cannon discloses.

Mr. Bruninga: What do you think he says?

Mr. Schimmel: Read it—"It is clearly a well drilling fluid which contains starch and caustic soda, a solution containing one percent caustic soda, and although it is not so stated by the Cannon patent, it is a fact that the pH diluted one percent solution of caustic soda is just under 13."

It strikes me that is what the Court has held there that Cannon discloses. I don't think there is any materiality in what the witness is being asked.

The Court: I don't think so.

Tr. 72 Mr. Bruninga: I ask him the same question, whether starch with quebracho performs the same function, substantially the same way. That is what I would like to have him answer.

A. No, starch and quebracho are not equivalents. Quebracho is used as a drilling mud thinner. Starch is used as the source of organic colloids to reduce water loss viscosity, to reduce water loss and contribute to viscosity.

Mr. Schimmel: In this case as distinguished from the preceding case, the Examiner has not only stuck to this starch or quebracho, but also has stuck to this caustic soda byline. In a drilling rig the caustic soda and lime, whether calcium oxide or calcium hydroxide, performs the same function in substantially the same way, secures substantially the same results.

The Witness: No, the only point of likeness between the two is that they both contribute to the alkalinity. The great point of difference between the two is their effect when they combine with the clay mineral in the drilling fluid. In the one case the sodium hydroxide or caustic soda virtually combines with the clay mineral and it swells, a combination with considerable water. In the other case, when calcium hydroxide is used, the calcium

replaces the sodium on the surface of the clay mineral and virtually denatures it. In that case it cannot swell with water, and thereby does not contribute to the vis-
Tr. 73 cosity of the drilling fluid, but rather contains it in like fashion as does the sodium type of clay.

Q. When you take lime and add water to a drilling fluid to the maximum amount that will dissolve, what is the pH? **A.** Approximately 12.5.

Q. If you now dump raw starch into such a fluid, whether water or a drilling fluid, will that gelatinize the starch? **A.** No, it will not gelatinize.

Q. Have you seen experiments performed on that? **A.** I have seen many, and have performed many. You cannot gelatinize corn starch at 12 pH when that pH is created by calcium hydroxide.

Q. Do you know of any statement in the literature that says so? **A.** No, I do not.

Q. I will demonstrate that before the Court by the next witness. Do you know whether, at a temperature of, say, around 100 degrees Centigrade, water or drilling fluid containing lime, say, calcium hydroxide or the lime itself—calcium oxide—if you put just as much in that fluid as you can, until you get 12.6 pH, run the temperature up to 100 degrees Centigrade, the boiling point of water, will that gelatinize raw starch? **A.** No, the raw starch will not gelatinize.

Q. Have you see that experiment made?
Tr. 74 **A.** Yes.

The Court: What would you do to make it gelatinize?

The Witness: In the well you would substitute sodium hydrox for it, and attain that pH, and in that case it would gelatinize. But the practice since 1941 has been not to hook up raw starch in the oil fields, but to buy gelatinized starch. It exists that way as soon as it mixes with water.

The Court: You can use that with calcium, can't you?

Can't you use that as in the Cannon patent, buy gelatinized starch already made up?

Mr. Bruninga: Gelantinized starch already made up, you ask me whether we can use it? I admit you can use it in the drilling fluid O. K., but we are talking about disclosure in a prior patent.

The Court: But the Court of Appeals says that although it is not so stated, the fact is that the pH value of one percent solution is not——

Mr. Bruninga: That is right. If you take one percent solution of caustic soda in water or drilling fluid, which gives us a pH of over 12, and you put raw starch in that, it will gelatinize, but our contention is that if you take that same kind of a fluid and bring the pH to 12.6 with just as much lime as will go in the solution, then——

The Court: The Cannon patent provides for lime, doesn't it?

Tr. 75 Mr. Bruninga: Yes, but he dont' say anything about how he does it. He just simply mentions lime. That is all.

The Court: He says:

> "The drilling fluid to be subjected to the above treatment can be a suspension of ordinary clay in sufficient proportions to form a light drilling fluid and containing sufficient alkaline material to render the mud distinctly alkaline" (page 1, Col. 2, lines 48-52).

That is an important thing, isn't it?

Mr. Bruninga: Yes, sir.

The Court: And that is an important thing, because you can't have the fluid too thin and you can't have it too thick.

The Witness: Yes, sir.

The Court: So that Cannon says the water is rendered highly alkaline. That is what you are anxious to have, isn't it?

The Witness: Yes, sir.

The Court: By means of caustic soda, caustic potash, lime or any other alkaline material. Is that correct?

The Witness: Yes, Your Honor.

Mr. Bruninga: I think I have stated my position, Your Honor.

The Court: I can see no invention in this case at all.

Mr. Bruninga: All right. That is the thing. We just want to develop the facts a little bit, then we are through.

Tr. 76 The Court: This business of using lime, there is no invention in that.

By Mr. Bruninga:

Q. The Board of Appeals talks about putting lime in the well that was hot, and let us say 180 degrees Fahrenheit, and that then gelatinization of starch will take place. How deep is a well, in feet, in order for the drilling fluid to circulate in the well at a temperature of 180 degrees Fahrenheit? **A.** On the average it will be about 8,000 feet deep to reach a temperature where it will achieve 180.

Q. Do any of the Illinois wells have such a depth? **A.** I don't know of any. Most of the wells in the central Illinois field are 3,000 to 5,000 feet.

Q. How about those in California, as a rule? **A.** I would say that one out of ten to fifteen would be greater than that depth.

Q. In your opinion—and I know you are employed by the Baroid Sales Division of National Lead Company—can you tell me whether or not this lime-starch system was or was not a substantial contribution to the drilling art? **A.** I saw this after 1945, and we induced several people to use lime in place of caustic soda in the high pH system. Those that went to it stayed with it, so that we replaced fully eight wells out of ten in the high Tr. 77 pH system, replacing caustic soda with lime, and the end result was a substantial saving to the drilling company. That replacement material was required to maintain the mud in the condition that they desired it during subsequent drilling.

Mr. Bruninga: Of course, I am going to furnish these papers that I have in Exhibit 1. I won't be able to get those for a few days, of course. I would include the affidavit of Larsen, filed May 19, 1950, page 8 of Exhibit 1, which states that at that time, 1950, at least one-half of the drilling used refined mud.

Also, the affidavit of Offeman, which is to the effect that when you add starch to a caustic soda solution in water, up to a percentage of one percent, with a pH of 12.6, the solution becomes translucent, in other words, a gel. Before that it settles out.

Furthermore, that if you proceed the same way with lime and add it up to even 2 percent to a pH of 12.4, the starch settles out, does not fill out.

Tr. 78 **Cross-Examination.**

By Mr. Schimmel:

Q. Mr. Farnum, I believe you stated, did you not, that caustic was used for thinning the drilling mud? **A.** The mixture of caustic and quebracho is used.

Q. Caustic alone? **A.** No.

Q. Caustic soda alone will not do it? **A.** No. That will increase viscosity.

Q. Did you also state that lime would tend to thin it? **A.** No, lime will first thicken it, then as it destroys the clay colloids, the whole system goes to work with water.

Q. In so far as the initial effect is concerned, both caustic and lime have the same effect on drilling mud? **A.** Initial effect, yes, in so far as viscosity is concerned.

Q. That is what I meant.

Isn't it true that lime is generally considered to be a caustic alkali?

A. I wouldn't say that, I would say alkali.

Q. Would you say that caustic lime is generally considered to be caustic alkali? **A.** I would think that that would be true. Those are descriptive terms, and they are not subject to exact definition.

Tr. 79 **Q.** It would be your opinion as an expert that caustic lime would be a caustic alkali? **A.** I would avoid the words "caustic alkali."

Q. I am not sure whether you are changing your answer or not. **A.** I would prefer not to use the words "caustic alkali" to describe a very definite chemical. I would rather call it calcium oxide, calcium hydroxide or alkali, which it is. That is very definite, but "caustic"—that is a descriptive term.

Q. You have no hesitancy in calling sodium hydroxide a caustic alkali? **A.** Caustic soda is a caustic alkali.

Q. Sodium hydroxide, lithium hydroxide, no difference, is there, from caustic alkali? **A.** No.

Q. That has the same effect as potassium hydroxide? **A.** Yes, sir.

Q. You would also class ammonia with caustic hydroxide? **A.** No, I would hesitate there. In my mind the connotation "caustic" means to burn the skin.

Q. Won't ammonia burn the skin? **A.** To a degree, but not like the potassium hydroxide will, as far as that word goes. I can use the term "lunar caustic," which is silver nitrate, not an alkali at all.

Tr. 80 **Q.** I am asking you about caustic alkali. **A.** I would go along on caustic alkali for sodium, lithium, potassium hydroxide only.

Q. If I were to tell you that Webster's International Dictionary defines caustic alkali as hydroxide of alkali metals, sometimes including caustic ammonia and caustic lime, would you agree with that? **A.** If you say it was the last, I would not agree. Lime is not an alkali metal.

Q. I said hydroxide of alkali metals, sometimes including caustic ammonia and caustic lime. Would you say you disagree, or do you agree? **A.** I would disagree with everything after "sometimes."

Mr. Schimmel: I would like the Court to take judicial notice of the definition in Webster's New International Dictionary, page 428, second edition.

By Mr. Schimmel:

Q. May I ask you, are you making any distinction at all between calcium hydroxide and lime? **A.** No, in my mind lime is calcium hydroxide or calcium hydrate.

Q. You are using them synonymously in your testimony, I gather? **A.** I believe I have. That is my thought in the matter.

Tr. 81 **Q.** And when you were comparing caustic soda with lime as to their corrosiveness and poison characteristics, you were referring to calcium hydroxide, weren't you? **A.** Lime which is calcium hydroxide, yes, and caustic sodium, sodium hydroxide.

Q. May I ask you whether in your opinion the alkaline earth oxides used is magnesium oxide? **A.** An alkali earth oxide is magnesium hydroxide.

Q. Or oxide? **A.** Or oxide, and also the calcium.

Q. Do you know that you can attain pH 12.12, about, with magnesium oxide? **A.** A little lower that that. I am not certain as to the maximum pH that will be attained by magnesium hydroxide.

Q. If you will refer to the table of pH values, to be Defendants' Exhibit 3, there is a statement there that the magnesia will attain pH 10.5. **A.** That magnesia is magnesium hydroxide.

Q. Magnesia—that would be magnesium hydroxide, would it? **A.** Yes, magnesia means magnesium oxide, and saturated with, in the case that it was in water and had hydroxide form, that is the maximum pH attainable.

Q. If that be true, wouldn't it be impossible to operate this process with magnesia? **A.** There would be— Tr. 82 you are referring now to substituting magnesium for calcium hydroxide?

Q. Correct, to attain all the advantages of reduced viscosity. **A.** You could obtain the advantages of reducing viscosity as regards the probable fermentation of the starch. You are getting fairly close to the border line there.

Q. You wouldn't call pH 10.5 about 12, would you? **A.** Oh, no.

Q. And if the claim of maintenance of mud fluid at a pH of about 12, or attaining a mud fluid containing starch at a pH of 12, would it do either one of those? **A.** Not with magnesium alone, no, sir.

Q. Let me ask you this, Mr. Farnham, is it customary at the present time, or has it been customary in times past in the art, in using a mud-drilling fluid, to subject it to testing before you actually use it in the field? **A.** Test the mud itself?

Q. Test the mud itself. **A.** On new products we will make pilot tests in the laboratory. On old mud in present use, to evaluate the material in the field, we test the mud as drilling proceeds, you might say at the time the materials are added in the field.

Q. I think that in order to see clearly as to those instances where you are adding a new material to Tr. 83 a drilling product, would it be common practice to test that first under simulated well conditions? **A.** As best we should in the laboratory. yes.

Q. And has that been common practice? **A.** Yes, that is so.

Q. Would that by any chance be what you call "aging"? **A.** Yes. The aging business is that of subjecting sealed jars to temperatures approximating the bottom hole in a well, to determine the effect over 12 hours on the mud of that heat. We find that it is necessary to make both the clay colloid and the organic compound expand to the fullest.

Q. When you say that you made the test with raw starch and the drilling mud at a pH of 12.5 with lime, was that aged? **A.** The base mud was aged. The actual cooking of the starch and the mud was a matter of minutes, that is, it would hydrolize although not immediately.

Q. In other words, you did not perform the usual aging at that time? **A.** No, it would not be necessary in that case. We would age only for one reason, and that would be because the colloid, to assume its full dispersion—you didn't have any reference to bacterial growth in aging, did you?

Q. No, I was just thinking about what is generally meant by the word "aging." Will you look at Tr. 84 DX 2, pages 2 and 5, and comment on a statement which appears in the original application which was before the Court:

> "In some cases, preheating of starch for employment in a well-drilling fluid is not even necessary, because the temperature at the bottom of the deep well is frequently in the neighborhood of 180 degrees F.; accordingly, even dry starch when added to the drilling fluid at the top of the well, at the top of such a well, will become gelatinized at the bottom of the well."

And it is my understanding that your statement is that if lime is used to create a pH in such a drilling mud, there will be no gelatinization? **A.** That is right. If there were lime present, calcium hydroxide, in this drilling mud system, the raw starch would not gelatinize.

Q. It is also my impression that when you testified in this case you said you were familiar with that application? **A.** Yes, the adding of starch.

Q. The application that was involved in the suit that you spoke of? **A.** That is the application in West Texas of raw starch?

Q. This is the patent application to which you testified in the suit two years ago. Now, is there anything in that application that will indicate that the results Tr. 85 would not be obtained if lime were used as an alkalizing material? **A.** I don't think so.

Q. In other words, so far as the application is concerned, every alkali would give that result? **A.** No, I don't think that is the case. I can state exactly what the situation would be, if you like.

Q. I am just trying to reconcile the statements which are inconsistent with each other. There was a presentation in this case before the Patent Office and before the Court that lime would give that result. **A.** I don't think I said that or implied it. At that time I knew that the——

Q. At that time you knew it would not? **A.** I knew that lime would prevent the gelatinization of starch in water.

Q. Let us get back to gelatinization. Starch will gelatinize in hot water, won't it? **A.** That's right.

Q. Without any alkali? **A.** With plain water.

Q. You don't need to alkalize the water? Do you ever heat the water to gelatinize? **A.** No. The more alkali you add, the lower becomes the temperature of gelatinization, until at pH 12½ or 13, it can be gelatinized immediately at room temperature.

Tr. 86 **Q.** Does it make any difference what alkali is used? **A.** Yes, certainly with calcium hydroxide it will not gelatinize at any temperature.

Q. Do you know any hydroxide that won't gelatinize? **A.** I have never made the experiment, but I would doubt whether it would gelatinize with magnesium hydroxide present.

Q. Would it gelatinize with barium or strontium? **A.** I would not expect it to.

Q. In other words, from what I gather, you say now that no alkaline hydroxide would gelatinize starch, even when heated? **A.** Calcium, magnesium, strontium, barium. I know for a certainty that with calcium hydroxide I have done it. I don't know about the others. I presume they would behave in essentially the same manner, because they are essentially the same type of elements.

Q. In other words, your opinion that the mere hydrogenized concentration is not sufficient to gelatinize, even though the water is hot? In fact, it goes the other way? Under your testimony the presence of that material hinders gelatinization of the starch which would normally gelatinize? **A.** That is the way I would rather put it, that the presence of calcium hydroxide will prevent the gelatinization of the starch.

Mr. Schimmel: That will be all.

Tr. 87 **Redirect Examination.**

By Mr. Bruninga:

Q. What happens if you add burned lime (CaO) to a drilling fluid containing water? **A.** It would flocculate the clay, increase the viscosity, and water loss, virtually destroy the clay colloids.

Q. Is there any change in CaO by adding water? **A.** It first assumes a hydroxide form and then ionizes the calcium to $Ca(OH)_2$.

Q. As a matter of fact, then, to add burned lime to the drilling fluid, what you would actually have in the drilling fluid is calcium hydroxide? **A.** That's right.

Q. And not burned lime? **A.** That's right.

Q. Now, counsel asked you about aging. Take Exhibit No. 1, page 25, which is the affidavit of Offeman, counsel asked you about aging. Do you find: "and there was complete settling of the starch upon standing, leaving a clear supernatant liquid"? **A.** Yes, I have that.

Q. Is there anything about aging in there? **A.** These experiments with starch were attempts to gelatinize by sodium hydroxide and calcium hydroxide. The time element is up to 18 hours, and the appearance of the

Tr. 88 systems were reported after that length of time.

Q. Now, referring to DX 2, page 8, it says: "However, lime, $Ca(OH)_2$ may be employed, particularly as soda lime." **A.** That is a mixture of calcium and sodium hydroxides.

Q. That has sodium hydroxide in it? **A.** Yes.

Q. Then, going back to DX 2, pages 2 and 3, the part that counsel read to you, and about which he cross-examined you, if you have soda lime—that is, both calcium hydroxide and sodium hydroxide—at the bottom of a hot well, what would be your opinion as to the gelatinization of starch? **A.** Soda lime in the well would cause gelatinization in some ratio near 100 percent, calcium hydroxide 100, and sodium hydroxide, where that would occur, the exact point I don't know.

Mr. Bruninga: That's all. I would like to ask Mr. Larsen some questions.

(Witness excused.)

Thereupon—

DELMAR H. LARSEN

was called as a witness by and on behalf of the plaintiff and, being first duly sworn, was examined and testified as follows:

Tr. 89

Direct Examination.

By Mr. Bruninga:

Q. What is your name? **A.** Delmar H. Larsen.

Q. Where are you located? **A.** I live in Los Angeles, California.

Q. What is your business at the present time? **A.** I am a consulting engineer there.

Q. What is your education? Give it briefly. **A.** I have a

Bachelor and Master's Degree from the California Institute of Technology, both in chemistry, and I have studied some petroleum engineering in graduate courses at the University of California.

Q. What did you do after you finished your education? **A.** I went to work for the National Lead Company, the plaintiff in this action, in 1936, and I was with them until last year, when they moved to Texas.

Q. What job did you hold there? **A.** I was successively research chemist, manager of the laboratory and director of research.

Q. Are you still being consulted by the Baroid Sales Division of the National Lead Company? **A.** Yes, I am.

Q. Referring to PX 4, this lime-caustic soda treatment, do you recognize those tests on PX 4?
Tr. 90 **A.** Yes, I do. They were done at a time that I
was in the laboratory when they were being done, and I observed them. In fact, I directed their performance.

Q. You observed their performance? You observed the data? And were they reported to you? **A.** They were.

Q. On this affidavit appearing on page 22 of PX 1, are you the Larsen that made that affidavit? **A.** I am.

Q. Turn to page 24, the affidavit of Richard C. Offeman. You were still employed by Baroid Sales at that time? **A.** That's right.

Q. And under whose direction was that test made? **A.** It was made under my direction.

Q. Did you verify the test? **A.** Yes, I did.

Q. Did you check up the results? **A.** Yes, I watched Mr. Offeman while he was doing the work.

Q. How about his conclusions? Did you check on those conclusions in the last paragraph? **A.** Yes, I did.

Q. Do you know whether any tests were performed to determine whether starch would be gelatinized with lime, calcium hydroxide, at high temperatures of, say,
Tr. 91 around 100 degrees Centigrade, the boiling point
of water? **A.** Yes. At a later date, when the

work reported in the affidavit you just showed me was made, Mr. Offeman made similar tests which included heating of the mixtures of water, starch and alkali.

Q. Have you a copy of the results of that test? **A.** No, I do not.

Q. I happen to have one here. I will ask you if you sent a copy of that to me, which is the Offeman affidavit (handing paper to the witness)? **A.** Yes, I did.

Mr. Bruninga: I don't have the original. I will let counsel see this, though. I can't offer it because it is not signed by anybody.

By Mr. Bruninga:

Q. Can you discuss that test that was made by Offeman? **A.** Yes.

Mr. Schimmel: I think, Your Honor, I must object at this time to the witness testifying to something that some other person did, and the affidavit he made.

The Court: I will sustain the objection.

Mr. Bruninga: Your Honor, this test was made under this witness' direction.

The Court: If he saw the test, let him tell us about it, and not read from some affidavit. Were you there when the test was made?

The Witness: I was there when the test was made.

The Court: When was that?

The Witness: May I take just a minute, Your Honor, to examine this?

The Court: No, if you can't remember when it was, you can't use the affidavit or that carbon copy.

By Mr. Bruninga:

Q. I will ask you who prepared that particular affidavit? **A.** I did.

Q. You prepared it yourself?

The Court: You mean you prepared that affidavit?

The Witness: No.

The Court: Mr. Offeman signed it.

The Witness: Mr. Offeman prepared it in my office.

By Mr. Bruninga:

Q. Did you dictate that, or who dictated it? A. Mr. Offeman wrote this out. My secretary typed it. I have the only good typewriter there that will make a multiplicity of copies.

Mr. Bruninga: Have you got the file of the Patent Office there, Mr. Schimmel?

The Court: He can't testify from it.

Mr. Bruninga: No, I just wanted to find out if it was here, if it is in the Patent Office file (Official examiner's affidavit). It is part of the file.

Tr. 93 By Mr. Bruninga:

Q. Can you tell us what those tests were? A. Yes, the tests consisted of this: A mixture of 100 cubic centimeters of water, 3 grams of cornstarch, and some lime, slaked lime, enough to give saturation. They were mixed together and then they were heated, such a mixture was heated in a water bath to within a degree or two of the boiling point of water, and the mixture was maintained at that temperature for several minutes, and then the mixture was removed, allowed to cool and observed, and there was no evidence at all of gelatinization of the starch.

Q. What did you use, what kind of starch? A. Raw cornstarch.

Q. What kind of alkali? A. Calcium hydroxide.

Q. To what percentage? A. One percent, as I recall. It doesn't make too much difference, as long as put in enough so that you exceed the solubility of water and get the maximum pH that you can get with lime.

Q. Did you get any gelatinization of that starch by the calcium hydroxide at a temperature of 100 degrees? A. No, there was no gelatinization.

Tr. 94 **Q.** Do you know whether any microscopic examination was made of the starch? **A.** I know that microscopic examinations—there is a test, a test that I described once, which we have performed repeatedly, and on some of those occasions we have examined the starch microscopically, and you can see unswollen starch grains present.

Q. How about this particular test? **A.** On the particular test that was done in connection with Mr. Offeman's affidavit, I am quite sure that he examined the starch microscopically.

Q. Did you have an office at the Baroid Company at that time? **A.** Yes, I did.

Q. Where was it with respect to the laboratory where Mr. Offeman was working? **A.** It was in the laboratory section of the building, on the same hall.

Q. On the same hall? **A.** Yes.

Q. What was your job at that particular time that this test was made? **A.** I have had a good many changes of title. I was director of research, or the equivalent of that, manager of research and development.

Q. Under whose supervision was Mr. Offeman at that time? **A.** He was, broadly, under my supervision.

Tr. 95 **Q.** Did you watch him make those tests at all? **A.** Yes, I did.

Q. At whose instigation were the tests made? **A.** At mine.

Mr. Bruninga: That's all.

Cross-Examination.

By Mr. Schimmel:

Q. How long did you say this test took you? **A.** You see, my difficulty is that I haven't reviewed the affidavit quite recently, but, as I recall, it was five minutes, something of that period of time, or even longer. That has been usual in this test. It is surprising, the result—we were surprised when we found this out, and we had repeated it even in the presence of representatives of the Corn Products Refining Company. It is rather unusual. There have been a good many tests along the same order.

Q. Did you try indicating the time limit? **A.** I think we have tried prolonging the heating as long as 30 minutes without any substantial difference in result.

Q. Do you know that the time for gelatinization varies, both with respect to the type of starch which is being used, and also as to the gelatinization? **A.** That is true, although the boiling point of water is so greatly in excess of the usual temperatures for gelatinization of starch in Tr. 96 the absence of alkaline that we thought we were leaning over backward, and when you use caustic soda, gelatinization is instantaneous, that is, a matter of a second or two.

Mr. Schimmel: That's all.

Redirect Examination.

By Mr. Bruninga:

Q. What is 95 degrees Centigrade? **A.** About 200 degrees. Fahrenheit.

Q. That is close enough. And you testified in the preceding case (Appeal No. 10,873), didn't you, the case just decided? **A.** Not directly.

Q. I mean you gave a deposition, didn't you? **A.** That is right.

Q. You are the same Larsen that gave the deposition in that case? **A.** Yes. I was not in the court room.

Mr. Bruninga: Now, Your Honor, I have talked with counsel about it and he seemed agreeable at the time that we can offer in this case the Beesley deposition appearing at pages 82 to 90, inclusive, of the record in Appeal No. 10,873. I don't think it is necessary to read it to you.

The Court: You are not putting in Larsen's deposition? You are just putting in the Beesley deposition?

Mr. Bruninga: Just Beesley, not Larsen. Also, I would like to put in the affidavit of John F. Dodge, appearing at pages 149 to 154, inclusive. Tr. 97

The Court: Is there any objection to that?

Mr. Schimmel: I haven't had a chance to consider the last one suggested, Your Honor. The first I have no objection to.

Mr. Bruninga: You let it in. All it relates to is really what is disclosed in the Bureau of Mines' report, the general effect of these starch emulsions.

Mr. Schimmel: I have no objection.

The Court: Very well.

Mr. Bruninga: That's all.

* * * * * * *

Dp. 1 Deposition of JACK H. BEESLEY taken (in appeal No. 10,873) on behalf of plaintiff, pursuant to notice, before Lois McMullin, a Notary Public, at the offices of Bruninga and Sutherland, Suite 302 at 1004 Market Street, St. Louis, Missouri, commencing on the 15th day of June, 1950, at 1:00 o'clock p. m. and continued to and resumed at 10:00 o'clock a. m., June 16, 1950, at the same place, until completed, on the part of the plaintiff.

Appearances:

John H. Bruninga, Esq., for plaintiff.

No appearance for defendant.

Dp. 2 JACK H. BEESLEY,

of lawful age, being produced, sworn and examined on behalf of plaintiff, deposes and says:

Direct Examination,

By Mr. Bruninga:

Q. What is your name? **A.** Jack H. Beesley.

Q. Where do you live? **A.** Tulsa, Oklahoma.

Q. What is your business? A. Division Sales Manager for the Baroid Sales Division of National Lead Company.

Q. How old are you? A. Forty.

Q. What has been your education, oh, just generally? A. Regular education, two years of college, University of Michigan.

Q. What did you do after you left college? A. Worked for the Standard Oil Company of Indiana.

Q. Doing what? A. Warehouse.

Q. Did you get out in the field work at all? A. No, that was domestic sales.

Dp. 3 Q. When did you first get out on field work? A. 1937.

Q. What kind of work was that? A. You are talking about oil field work?

Q. Yes. A. That was roughnecking.

Q. A "roughneck" really is an apprentice, isn't he? A. He is a laborer on a drilling rig.

Q. Where was that? A. Corpus Christi, Texas.

Q. And that was on a rig drilling an oil or gas well? A. Drilling for oil.

Q. How long did you stay on that job? A. I was on that work for five month.

Q. What did you do then? A. Went to work for George S. Mepham Corporation, service engineer.

Q. What was Mepham selling? A. Were selling Colox.

Q. Colox was what? A. Comparable to Baroid.

Q. But Colox was finely ground iron oxide? A. That is right.

Dp. 4 Q. And Baroid was finely ground barites? A. Yes.

Q. And that was used as mud weighting material? A. Yes.

Q. Now, how long did you stay with Mepham? A. Two and one-half years.

Q. And where did you go then? A. Baroid.

Q. By the way, where did you work for Mepham as sales engineer? **A.** I worked for them in Oklahoma City, Lake Charles, Louisiana, New Orleans, and in Illinois.

Q. What was the work of sales engineer, what was the nature of your work? **A.** Was to analyze the mud in different drilling wells and to make recommendations for better use of the mud to keep running wells out of trouble and overcome trouble that had already occurred.

Q. Did not Mepham sell a phosphate at that time? **A.** They did.

Q. What was that phosphate used for? **A.** Thinning muds.

Q. Now, what you did in your job as sales manager was really to call on the people at the wells to see Dp. 5 what they needed, isn't that right? **A.** That is right; influence them in the use of materials and to help them overcome difficulties in drilling wells.

Q. But the actual stuff was sold by distributors of Mepham, wasn't it? **A.** That is right.

Q. Now, you came to Baroid, I believe you said, in 1939? Same kind of a job? **A.** Same kind of capacity.

Q. And Baroid at that time was selling Baroid, it was ground barites also? **A.** Yes.

Q. And Aquagel, which is Wyoming Bentonite? **A.** Yes.

Q. And that was also added to the drilling mud? **A.** Yes.

Q. Now, Baroid Sales was also selling Stabilite at that time, which was a phosphate? **A.** That is right.

Q. Now, the Baroid was used to weight down the mud, isn't that right? **A.** We call it weighting it up. I guess weighting it down would be proper also.

Dp. 6 **Q.** And Aquagel was used at that time to add to the colloidal properties? **A.** Increase the viscosity.

Q. Increase the viscosity of mud, and Stabilite was used to—— **A.** Reduce the viscosity.

Q. Now, you need all those three, don't you, in most areas? **A.** That is right.

Q. And you went out in the field the same way to see what was needed? **A.** That is right.

Q. Now, how did you measure the viscosity, what kind of instrument did you use? **A.** Marsch funnel and sometimes a Stormer.

Q. Now, the funnel, the Marsch funnel, was just a funnel that you poured your mud fluid in and let the mud run out and you timed how many seconds it took to make a certain amount? **A.** That is right.

Q. And that was given in seconds, was it not? **A.** Given in seconds.

Q. But the Stormer gave in what is known as centipoises? **A.** That is right.

Q. And you also used the Stormer to give the gel strength, didn't you? **A.** That is right. Dp. 7

Q. That is, to gel the mud fluid. Now, a mud fluid is a pretty ticklish thing to handle, isn't it, to keep it in control? **A.** That is right.

Q. What happens if you don't keep it in control? **A.** The tool may become stuck, or something else happen to keep you from completing the hole or making as much time on it as is required.

Q. What fields did you cover for Baroid Sales? **A.** Indiana, Michigan, Kansas and Colorado, Illinois and Kentucky.

Q. Now, your job is division sales manager, do you have a lot of these technical men like you under you? **A.** Yes. Not under me, we have them with the company, they are under the field division superintendent.

Q. But you rose to that point where you became division sales manager? **A.** That is right.

Q. Now, you are the Jack H. Beesley who is the applicant, who filed the application, or rather, signed the application, with D. A. Sikes, serial 489,890, and which is involved in this suit, isn't that right? **A.** That is right.

Dp. 8 **Q.** Now, do you know what water loss is? **A.** Water loss is the amount of fluid, water pressed from mud under 100 pounds pressure.

Q. Now, in the drilling of this well the mud fluid goes down the drill pipe, comes out at the bottom and rises on the outside and carries the cuttings with it, the cuttings are deposited in a ditch or taken out by a screen, then run over to a sump or tank? **A.** That is right.

Q. Now, that drilling mud has got water in it, hasn't it? **A.** That is right.

Q. And that can go down and go into the formation, that is right, isn't it? **A.** Yes.

Q. Now, suppose you struck a producing formation for gas or oil and a lot of water gets into that formation, what happens? **A.** They retard the production of oil or gas from that formation.

Q. In other words, you have got a lot of water in that formation that you have to get out some time later on? **A.** Also water goes in to the formation of high porosity, which would allow mud to be built upon the side
Dp. 9 of the wall, thus making it hard, or impossible to withdraw drilling tools from the well.

Q. Now, the idea is to keep as little water from going into that producing formation as possible, isn't that right? **A.** That is right.

Q. You have a way of measuring that, don't you, above the ground, what the water loss will be? **A.** Yes, we have a Baroid filter press.

Q. It is a tester that tells you in cubic centimeters in a certain length of time, isn't it? **A.** That is right.

Q. And say 5 c. c. or 5 cubic centimeters means a water loss of 5 c. c., isn't that right? **A.** Yes.

Q. And 20 means 20, and it is desirable to keep that water loss down? **A.** It is.

Q. Now, how about use of clays in that respect? **A.** Ordinary clays would not reduce it very much.

Q. How is Bentonite? **A.** Bentonite reduces it much farther.

Q. Supposing you strike a salt water, what happens then? **A.** The Bentonite does not give you a low water loss.

Dp. 10 **Q.** Now, then, you have sold Zeogel, what is that? **A.** Fuller's earth.

Q. That is recommended for salt water? **A.** For building viscosity in salt water.

Q. How about the water loss? **A.** The water loss is very high.

Q. Now, this case involves the use of starch in drilling mud and more particularly at a high p. H. of about 12. Now, do you know what Imperex is? **A.** It is a starch, a hydrolized or gelatinized starch.

Q. It is not a raw starch like corn starch, is it? **A.** No.

Q. The Baroid Sales sells that? **A.** Yes.

Q. Do you remember what year it was first sold? **A.** Came out in 1941.

Q. Did you sell any of it? **A.** Yes, I did.

Q. Did you service any of it? **A.** I did.

Q. How was the starch, for instance in a tester, as far as water loss is concerned, a tester above the
Dp. 11 ground, does it give a low water loss? **A.** You mean the starch by itself?

Q. I mean a gelatinized starch when you first start it. **A.** Yes.

Q. What happens to it when you have starch in a well? **A.** It ferments or otherwise deteriorates.

Q. What happens to the water loss? **A.** Which increases the water loss and increases the viscosity of the drilling fluid.

Q. Did you try anything to stop that sort of fermentation? **A.** Yes, tried creosote.

Q. What did that do? **A.** That didn't arrest the fermentation.

Q. It didn't kill the "bugs" in there? **A.** That is right.

Q. Now, we are talking now about your high p. H. of 12, using a gelatinized starch or starchy colloid at a p. H. of about 12 in drilling a well to get you a low water loss. Do you remember when you started doing that? **A.** It was in 1941.

Q. Now then, what did you use to get that p. H. in the first place? **A.** Used lime.

Dp. 12 **Q.** What kind of lime? **A.** Just hydrated lime.

Q. How did it work? **A.** Worked very well; arrested the fermentation of the starch and allowed the well to be completed without trouble.

Q. About what p. H. did you carry? **A.** Maintained the p. H. at 12.

Q. And it worked at that? **A.** Worked at 12.

Q. What did it do to the water loss? **A.** Reduced the water loss and kept it there, maintained the water loss.

Q. At a lower point? **A.** Yes.

Q. Lower point than Aquagel? **A.** Yes.

Q. But it stopped the fermentation, didn't it? **A.** That is right.

Q. Was anything used outside of lime after that? **A.** Yes, we used Aquagel after that to increase the viscosity.

Q. Did you use anything instead of lime to give a high p. H.? **A.** No.

Dp. 13 **Q.** I mean, after that? **A.** After that we used caustic soda.

Q. Now, do you use lime now? **A.** Some lime is used, but caustic soda is also used.

Q. But lime is used with Impermex, isn't it? **A.** Yes.

Q. And caustic soda is used with Impermex to give you a p. H. of 12? **A.** Yes.

Q. And where lime is used it is called lime Impermex system, isn't it? **A.** Yes.

Q. It works, doesn't it? **A.** It works very well.

Q. Do you use starch only in drilling a well? **A.** No.

Q. What do you use? **A.** We use some clay that is made in the hole and use Bentonite or Aquagel.

Q. When you use Bentonite or Aquagel about what proportion do you use? **A.** About 3%.

Q. Suppose you run it up to 10, 20 or 30, what Dp. 14 would happen then? **A.** The fluid would be so thick we would be unable to pump it or use it.

Q. What is about the highest you ever used Bentonite in a well, the highest percentage? **A.** Oh, six or seven per cent.

Q. But nothing like 10, 20 or 30? **A.** No.

Q. Now, you make up your drilling fluid now with either lime or caustic soda, bring it to a p. H. of about 12, you add a starch until you get your water loss down to where you want it, and you start drilling, and you just go to sleep then? **A.** No, it must always be maintained at a p. H. of 12 or above.

Q. What happens if you don't maintain it? **A.** It would ferment or decompose.

Q. So, just making it up and forgetting it wouldn't do? **A.** It would not be sufficient.

Q. You also have to add starch? **A.** Yes, you do.

Q. To maintain the water loss? **A.** To maintain the water loss.

Q. In the drilling of a well you start your drilling and keep on adding clay solids to it and maybe water Dp. 15 will run into it? **A.** Yes.

Q. And sometimes you have to use a viscosity reducing agent even with starch? **A.** Yes.

Q. What do you use? **A.** Quebracho.

Q. How about Stabilite, one of these phosphates? **A.** They will work, can be used somewhat.

Q. Now, what water loss in c. c., cubic centimeters, do you try to get down to with starch? **A.** Try to get down to 5 or below.

Q. Can you do that with Bentonite? **A.** No.

Q. What is the highest you have seen Bentonite get it down to? **A.** With good water and no other device 10 would probably be a low, otherwise 15.

Q. How about if you encountered salt water? **A.** Your water loss would be very high.

Q. Now, with Zeogel what could you get the water loss down to? **A.** 50 to 55.

Q. In what fields have you seen this Impermex, that is, the starch, at a high p. H. system used, whether Dp. 16 using caustic soda or lime? **A.** In Illinois, Kansas, Oklahoma, Colorado, Michigan.

Q. Is it still being used? **A.** It is being used extensively, especially the Gulf Coast, some parts of Oklahoma, and West Texas today.

Q. It hasn't gone out of the window at all? **A.** Oh, no.

Q. Do you know whether lots of Impermex is being sold? **A.** A great deal of it is being sold.

Q. Now, do you know what Quebracho is? **A.** Yes.

Q. It is a tannic acid, isn't it? **A.** It is.

Q. And what is it used for? **A.** It is used to reduce viscosity in different fluids.

Q. Has it been used for that purpose since you have had connection wtih it? **A.** It has for years.

Q. Supposing you use caustic and Quebracho? **A.** It is a thinning agent.

Q. Not a thickening agent, is it? **A.** No.

Q. Is gelatinized starch used for that purpose as Dp. 17 a thinning agent? **A.** No, gelatinized starch is not used for a thinning agent.

Q. In the wells where you get low water loss what does it do, increase or decrease the viscosity? **A.** Increased the viscosity.

Q. You said starch is used to reduce water loss? **A.** That is right.

Q. That is its primary purpose? **A.** Primary purpose.

Q. It is not used to prevent shale from heaving, is it? **A.** No.

Q. If you had no fermentation of starch in a well would you have to use either caustic or lime with a high p. H.? **A.** No, sir.

Q. Do you know what Quebracho does when you put it in water, dissolve? **A.** Dissolves, yes, sir.

Q. Forms a solution, doesn't it? **A.** That is right.

Q. What does gelatinized starch do when you put it in water? **A.** Increases the viscosity.

Q. I mean, what is it, it don't look like water, does it? **A.** No, it looks like gravy or paste.

* * * * * * *

Affidavit of John F. Dodge.

(In Appeal No. 10,873.)

State of California }
County of Los Angeles } ss.

John F. Dodge, being duly sworn, deposes and says as follows:

I am a graduate of the University of California College of Mining, Bachelor of Science in Mining Engineering, 1912; University of Southern California, Master of Science in Chemistry of Petroleum, 1915; Professional Degree of Mining Engineer, University of California, 1924. At present and since 1929 I am and have been Professor of Petroleum Engineering and Chairman of the Division of Petroleum Engineering, University of Southern California. The last thirty years I have been engaged in Petroleum Engineering in California, Texas and other parts of the world, and particularly since 1925 I have been engaged in research and Field Application of studies of drilling muds. The practical application of the principles of drilling muds was also included in my previous experience, where I rose to Engineer in Charge of Development, both in the Gulf Coast and in California, in drilling operations.

Importance of the Use of Low Water-Loss Mud.

The importance of the use of low water-loss mud in drilling and completion practice of oil wells may be considered in relation to at least three major effects on the results obtained, as follows:

(1) Effect on the drilling operation itself.

(2) Effect on the productivity of the reservoir sand.

(3) Effect on fluid content of the sands immediately adjacent to the hole and on cores taken with resultant effect on accuracy of conclusions as to probable productivity of sands penetrated.

Low Water-Loss Muds in Drilling Operation—Due to the more or less direct relationship obtaining between water-loss and thickness of cake built up on the wall of the hole, the use of low water-loss drilling fluids of the kind under discussion results in the deposition of extremely thin but relatively impermeable cakes, thus minimizing reduction of hole diameter. A high water-loss mud which deposits a thick cake reduces the effective area for circulation of drilling fluid, thus increasing pump pressures or reducing circulation rates for any given available pump pressure. Drilling is thus slowed down due to incomplete removal of cuttings from the well bore, tools become stuck more readily and greater difficulty is experienced in coming out or going into the hole. In many instances, with the use of poor muds, it is necessary to ream down or circulate down by stages in order to get the tools back on bottom, with the resultant loss in effective drilling time. The use of a low water-loss mud, on the other hand, allows the tools to be run to bottom without delay.

Thick mud cakes also give great difficulty in coming out of the hole due to a swabbing effect by tool points, drill collar, bits, and particularly drill pipe protectors or stabilizers. Portions of the cake are swabbed off from the wall of the hole, interfering with the removal of the tools and impeding circulation when drilling is resumed after the bit is again on bottom. Low water-loss muds with thin cakes give very little trouble due to swabbing. A further factor worthy of mention is the relative ease of recovery of lost tools after a drill pipe failure or twist-off. Low water-loss muds with thin wall cakes facilitate the recovery of the fish by minimizing difficulties in getting over the fish and recovering it from the hole.

Low water-loss muds with their thin wall cakes facilitate the running of casing, cementing operations, the landing of liners, and the bringing in of the well since there is relatively little cake material behind the pipe to clog perforations and reduce the effectiveness of the perforated liner or screen pipe. Poor muds of high water-loss slow down drilling operations and therefore multiply the damage out of proportion to their water-loss rate.

Effect on the Productivity of the Sand—Loss of water to the sand being penetrated by the bit results in the hydrocarbons in the pore spaces of the sand being driven back into the formation a distance proportional to the water lost by the drilling fluid during the time the sand is exposed to its action. The invasion of the sand is therefore a function of the rate of water-loss in a given time multiplied by the time of exposure.

The water which invades the sand not only has to be removed before the oil or gas can enter the well but in many instances seriously and permanently affects the permeability of the sand to oil and gas, thus reducing the productivity of the well.

This is particularly true of sands of low permeability which contain clay particles disseminated throughout the reservoir sand. Chemical and physical changes in the structure of these clay particles are effected by the fresh water from the drilling fluid, resulting in swelling of the clay particles and irreparable damage to the reservoir sand.

Instances are on record where wells have produced as much as 1100 barrels per day on test, and when finally completed after some days' or weeks' exposure to high water-loss muds, fail of any production whatever due to damage to the sands by invasion of water from the drilling fluid.

The use of low water-loss muds is considered to be of paramount importance in many of the deep fields of the San Joaquin Valley in California and in Eastern Venezuela, where the reservoir sands carry appreciable amounts of bentonitic clays, but damage is not confined to sands of this character alone. Both laboratory tests and field experience demonstrate the superior productive capacity of wells completed with low water-loss muds, even in sands of relatively high permeability and freedom from contamination by clay or other unstable minerals.

Effect of Testing Results—The invasion of the formation by excessive amounts of water from the drilling fluids affects the resistivity and self-potential values of the electric log, giving rise to difficulty in interpretation and frequent erroneous conclusions. The so-called deep penetration or lateral penetration curve of some electric logs has been developed in an attempt to escape from this difficulty, but its correlation with ordinary resistivity curves is difficult and uncertain.

Excess amounts of drilling water in the formation give rise to erroneous conclusions in many instances in drill stem formation tests. The fluids which enter the hole and are caught and sampled are those adjacent to the well bore, and failure of conclusive tests because of drilling water contamination are very frequent where high water-loss muds are used.

Finally, the determination of the probable fluid content of the formation by analysis of core samples is rendered difficult, if not completely unreliable, when high water-loss muds are employed in coring. The use of low water-loss muds reduces the flushing effect while the core is being cut and minimizes the contamination of the core by the drilling fluid.

In each of the above-mentioned instances more dependable information as to reservoir characteristics and probable fluid content is obtained by the use of low water-loss muds and the danger of financial loss from wrong conclusions as to conditions obtaining in the reservoir reduced proportionally.

The Subject Matter Here—

I am familiar with the procedure of drilling wells by the employment of an aqueous well-drilling fluid or mud, comprising, bringing and maintaining the fluid to a pH of about 12, and adding to the fluid sufficient of a starchy colloid to attain a substantial wall-seal of low water-loss, viz., below 5 c. c. (A. P. I.) and at an operable well-drilling viscosity. This procedure, to my knowledge, is something entirely new in the art and has gone into wide use and has been found highly successful. The attainment of a waterloss as low as 5 c. c. is important in order to attain the objects and results previously noted by me.

I am familiar with the Bureau of Mines report on investigations, R. I. No. 356, February, 1941, and particularly pages 76-77, relating to the employment of starch, with reference to the following statement in that publication:

> "It is only recently that starch has found application in drilling muds as a result of the development that hydrolyzed starch imparts a good filter test to salt-water mud. For this purpose the starch may be hydrolyzed by boiling a 10 percent starch suspension

> in sodium hydroxide (1 percent by weight; or starch: sodium hydroxide 10:1). A pH of about 11 or 12 has been found desirable'' (p. 77).

That statement does not teach me, and did not teach me at the time that I read it, that the drilling mud or fluid itself was to be maintained at a pH of 11 or 12. Furthermore, that publication does not disclose the employment of sufficient starch to a drilling fluid or mud, brought to or maintained at a pH of about 12, in order to attain a substantial wall-seal of low water-loss, viz., below 5 c. c. (A. P. I.) at an operable well-drilling viscosity.

John F. Dodge.

Sworn and subscribed before me this 25th day of August, 1945.

My commission expires July 27, 1948.

A. S. West,
(Seal) Notary Public.

PLAINTIFF'S EXHIBIT 1.

Pending Application of
Dee A. Sikes and
Jack H. Beesley
Filed March 11, 1946, Serial Number 653,716,
for
Improvement in Treatment of Well Drilling Fluids.

Note: Cancellations are noted by lining ~~(lining)~~ out, amendments (by pen) in black-face type.

1 **Specification.**

To All Whom It May Concern:

Be It Known That We, Dee A. Sikes and Jack H. Beesley, citizens of the United States, and residing, respectively, in the City of Tulsa, County of Tulsa, State of Oklahoma, and Great Bend, County of Barton, State of Kansas, have invented the new and useful improvement in

Treatment of Well Drilling Fluids

of which the following is a specification:

2 This invention relates to the treatment of well drilling fluids, particularly as used in the rotary method of boring and controlling oil and gas well. This application is a continuation of Application Serial No. 489,890, filed June 7, 1943, as to common subject-matter.

A well-drilling fluid of the character described is generally of the aqueous type, that is, the external phase is water which may be laden with clay or an amylaceous **emulsoid** colloid, such as gelatinized starch, or both. The aqueous phase may be fresh water or salt water, and, of course, is subject to the entrainment of formation solids or soluble salts. The clay may be a suitable drilling clay or a concentrated colloidal clay such as bentonite. The starch base may be of corn, potato, tapioca, rice, arrowroot, sago, palm, wheat, the by-products of flour, such as shipstuff, shorts and middlings, etc., all of which are hereinafter referred to as ''amylaceous colloids'' or ''starchy colloids.'' The starch is, of course, gelatinized in any suitable manner to provide an emulsoid colloid, an example of which is cold water laundry starch which gelatinizes in cold water. A thin-boiling starch prepared, for example, by mineral acid treatment gelatinized by cooking with water is particularly useful for this purpose; **see Patent No. 2,417,307.** Where starch is used with water it provides what may be called ''aqueous amylaceous-colloid-laden drilling fluid.''

Where starch is employed in a well-drilling fluid the starch reduces the water-loss markedly as compared with cases where clays, including bentonite and fuller's earth are used. The starch is, however, subject to deterioration, appH meter. Starch may also be added during the course of drilling to maintain the water-loss and clay may be added to compensate for that which will drop out. Where desired caustic soda **(sodium hydroxide)**, soda ash **(sodium carbonate)** or sodium bicarbonate may be added to control the pH. Where the alkaline-earth metal oxide is used rather than the hydroxide only one-third as much will be required to secure the same result.

It will be understood that this invention is applicable to salt water and fresh water drilling fluids. In the case of salt water drilling fluids more lime may be necessary than where fresh water is used. Sodium carbonate, Na_2CO_3 is also useful to precipitate **deleterious** calcium salts encountered during the course of drilling, examples of which are calcium chloride and calcium sulphate. While it is not necessary to use a chemical fermentation inhibitor, such inhibitor may be employed if desired.

While the theory of operation is not essential to the employment of this invention it is believed that the theory of action is about as follows. The high pH will cause shrinking of the clay lattice in the solid phase; there may also be a conversion of sodium to calcium clay or of a negative charge to a positive charge. The net result seems to be that the clay, if hydrated, will be dehydrated so that the gel-strength will be reduced to practically zero. The clay is, however, completely dispersed into fine particles practically on addition of the starch. The starch will combine with the small clay particles to form a very efficient water-seal or shut-off with a resultant low water-loss and a very thin cake thickness. The fluidity will be very high and while this may require increased velocities in order to carry the cuttings out of the well, the pump pressure will, of course, be reduced and withal there will be a low water-loss. **However, the viscosity of the drilling fluid may be maintained by the addition of a colloidal clay and more particularly a**

concentrated colloidal clay such as bentonite. Insert A^4**, pg. 13.** (See p. 88, infra.)

6 Having thus described the invention, what is: **(Claims 1-10 cancelled, page 11.)** (See p. 86, infra.)

1. In the art of drilling wells by the employment of an aqueous well-drilling fluid, the process comprising, preparing a drilling fluid of water, a clay, an amylaceous colloid and sufficient of an alkaline-earth metal oxide or hydroxide to attain a high pH fluid, viz., 12.

2. In the art of drilling wells by the employment of an aqueous well-drilling fluid, the process comprising, preparing a drilling fluid of water, a clay, an amylaceous colloid and sufficient of an alkaline-earth metal oxide or hydroxide to attain a high pH fluid, viz., 12, with sufficient of the amylaceous colloid to attain a low water-loss, viz., 5 c. c. (A. P. I.).

3. In the art of drilling wells by the employment of an aqueous well-drilling fluid, the process comprising, adding to an aqueous clay-laden drilling fluid sufficient of an alkaline-earth metal oxide or hydroxide to attain a high pH fluid, viz., 12, and thereafter adding an amylaceous colloid to said fluid.

4. In the art of drilling wells by the employment of an aqueous well-drilling fluid, the process comprising, adding to an aqueous clay-laden drilling fluid sufficient of an alkaline-earth metal oxide or hydroxide to attain a high pH fluid, viz., 12, and thereafter adding an amylaceous colloid to said fluid in an amount sufficient to attain a low water-loss, viz., 5 c. c. (A. P. I.).

5. In the art of drilling wells by the employment of an aqueous well-drilling fluid, the process comprising, preparing a drilling fluid of water, a clay, an amylaceous colloid,

and maintaining the fluid at a high pH, viz., 12, by an alkaline-earth metal oxide or hydroxide.

7 6. In the art of drilling wells by the employment of an aqueous well-drilling fluid, the process comprising, preparing a drilling fluid of water, a clay, an amylaceous colloid and sufficient of an alkaline-earth metal oxide or hydroxide to attain a high pH fluid, viz., 12, and thereafter maintaining said fluid at said pH.

7. In the art of drilling wells by the employment of an aqueous well-drilling fluid, the process comprising, adding to an aqueous clay-laden drilling fluid sufficient of an alkaline-earth metal oxide or hydroxide to attain a high pH fluid, viz., 12, and thereafter adding an amylaceous colloid to said fluid in an amount sufficient to attain a low water loss, viz., 5 c. c. (A. P. I), and thereafter maintaining said fluid at said pH and said water-loss.

8. An aqueous well-drilling fluid, comprising water, a clay, an amylaceous colloid and a sufficient addition of an alkaline-earth metal oxide or hydroxide to have a high pH, viz., 12.

9. An aqueous well-drilling fluid, comprising water, a clay, sufficient addition of an alkaline-earth metal oxide or hydroxide to have a high pH, viz., 12, and sufficient of an amylaceous colloid to have a low water-loss, viz., 5 c. c. (A. P. I.).

10. The process and drilling fluid substantially as described.

8 In testimony whereof, we affix our signatures on the date set opposite our respective names.

Dee A. Sikes Date 2/25/46.
Dee A. Sikes

Jack H. Beesley Date 3/ 2/46.
Jack H. Beesley

Oaths.

State of Oklahoma } ss.
County of Tulsa }

State of Kansas } ss.
County of Barton }

Dee A. Sikes and Jack H. Beesley, the above-named Petitioners, being duly sworn, depose and say that they are citizens of the United States and, respectively, residents of Tulsa, Oklahoma, and Great Bend, Kansas; that they verily believe themselves to be the original, first and joint inventors of the improvement in

Treatment of Well Drilling Fluids

described and claimed in the annexed specification; that they do not know and do not believe that the same was ever known or used before their invention or discovery thereof, or patented or described in any printed publication in any country before their invention or discovery thereof, or as to common subject-matter more than one year prior to their application, Serial No. 489,890, filed June 7, 1943, and as to subject-matter not common to the applications more than one year prior to this application, or in public use or on sale in the United States, as
to common subject-matter more than one year prior
9 to their application, Serial No. 489,890, filed June
7, 1943, and as to subject-matter not common to
the applications for more than one year prior to this application; that said invention has not been patented in any country foreign to the United States on an application filed by them or their legal representatives or assigns more than twelve months prior to this application; that no application for patent on said improvement has been filed by them or their legal representatives or assigns in any country foreign to the United States; that they have never abandoned the said invention; and that they duly executed the annexed Petition and Specification.

And said Jack H. Beesley further deposes and says that his real full name is "Jack" and that he was baptized under that name.

Dee A. Sikes,
Dee A. Sikes,
Jack H. Beesley.
Jack H. Beesley.

Said Dee A. Sikes sworn to and subscribed before me this 25th day of February, 1946.

My commission expires March 5, 1946.

Lillian Settles,
Notary Public within and for the
County of Tulsa, State of
Oklahoma.

Said Jack H. Beesley sworn to and subscribed before me this 2nd day of March, 1946.

My commission expires Mar. 6, 1949.

E. A. Kirkpatrick,
Notary Public within and for the
County of Barton, State of
Kansas.

10 St. Louis, Missouri,
March 27, 1947.

Filed April 1, 1947.

Hon. Commissioner of Patents
Washington, D. C.

Sir:

The Official Letter of October 4, 1946, was duly received, and the above-entitled application is hereby amended in response thereto as follows:

Specification

Page 2, line 8, after "amylaceous" insert—emulsoid—

Page 3, lines 14, 17 and 21 after "amylaceous" insert —emulsoid—

Page 3, cancel lines 28 through 33 and insert—

A^1 —Generally stated, and in accordance with an illustrative embodiment of this invention, an aqueous mud-laden well-drilling fluid containing an amylaceous-emulsoid-colloid is maintained during the course of drilling at a pH of about 12, viz., between 11.5 and 12.5, by addition thereto of an alkaline earth metal oxide or hydroxide. In order to maintain the drilling fluid during the course of drilling at a low water loss, viz., about 5 cc (API) there is added thereto sufficient of the amylaceous-emulsoid-colloid to effect that purpose. The drilling fluid may be prepared by initially bringing the fluid to a pH of about 12 and thereafter adding the amylaceous-emulsoid-colloid. Where deleterious calcium compounds are contained in the drilling fluid or entrained during the course of drilling, the
11 fluid may be maintained at a pH of about 12 during the course of drilling by an alkali, including an alkaline metal carbonate. A colloidal clay such as bentonite may also be added to the drilling fluid in order to
A^1 maintain its solid contents during the course of drilling.—

Page 4, line 14, after "concentrated" insert—colloidal—; same page, line 30 after "soda", first occurrence, insert —(sodium hydroxide)—; same line after "ash" insert —(sodium carbonate)—.

Page 5, line 7, after "precipitate" insert—deleterious—; same page, line 29, after the period add—

However, the viscosity of the drilling fluid may be maintained by the addition of a colloidal clay and more
A^2 particularly a concentrated colloidal clay, such as bentonite.—

Cancel all the claims 1 through 10 and insert the following claims:

A^3 11. In the art of drilling wells through formations by the employment of an aqueous mud-laden well-drilling fluid containing an amylaceous emulsoid colloid, **which is subject to deteriorating during the course**
B **of drilling,** the process, comprising, maintaining such a drilling fluid, during the course of drilling, at a pH of about 12 by addition thereto of an alkaline-
B earth metal oxide **in order to inhibit such deterioration.**

12. In the art of drilling wells through formations by the employment of an aqueous mud-laden well-drilling
B fluid containing an amylaceous emulsoid colloid, **which is subject to deterioration during the course of drilling,** the process, comprising, maintaining such a drilling fluid, during the course of drilling, at a pH
12 of about 12 by addition thereto of an alkaline-earth metal oxide **in order to inhibit such deterioration,**
B and maintaining the drilling fluid during the course of drilling, at a water loss of about 5 cc by addition thereto of the amylaceous-emulsoid-colloid.

13. In the art of drilling wells through formations by the employment of an aqueous mud-laden well-
Insert B^2 drilling fluid **B^2**, the process comprising, bring-
pg. 19 ing such a fluid to a pH of about 12 by addition thereto of an alkaline-earth metal oxide, adding to such a fluid an amylaceous-emulsoid-colloid, and maintaining the fluid during the course of drilling, at such pH

in order to inhibit deterioration of the amylaceous-
B **emulsoid-colloid.**

14. In the art of drilling wells through formations by
the employment of an aqueous mud-laden well-drill-
B ing fluid containing an amylaceous-emulsoid-colloid,
which is subject to deterioration during the course
of drilling, the process, comprising, bringing such a fluid
to a pH of about 12 by addition thereto of an alkaline-earth
metal oxide, and maintaining the fluid, during the
B course of drilling, at such pH **in order to inhibit**
such deterioration.

15. In the art of drilling wells through formations by
the employment of an aqueous mud-laden well-drilling
fluid $\mathbf{B}^3$, the process comprising, bringing such a
Insert B^3 fluid to a pH of about 12 by addition thereto of
pg. 20 an alkaline-earth metal oxide, then bringing such
a fluid to a water-loss of about 5 cc. by addition
thereto of an amylaceous-emulsoid-colloid, and maintaining
the fluid, during the course of drilling, at such a pH **in**
order to inhibit deterioration of the amylaceous-emulsoid-
colloid and at such water-loss.

16. In the art of drilling wells through formations containing
deleterious calcium compounds by the employment
of an aqueous mud-laden well-drilling fluid contain-
B ing an amylaceous-emulsoid-colloid **which is subject**
to deterioration during the course of drilling, the
A^3 process, comprising, bringing such a fluid to a pH
of about 12 by addition thereto of an alkaline-earth
13 metal oxide, and maintaining the fluid, during the
Insert B^4 course of drilling, at such pH by an alkali in-
pg. 20 cluding an alkali-metal carbonate $\mathbf{B}^4$.

17. In the art of drilling wells through formations by
the employment of an aqueous mud-laden well-drilling fluid

containing an amylaceous-emulsoid-colloid **which is**
B **subject to deterioration during the course of drilling,**
the process, comprising, maintaining such a drilling
B fluid, during the course of drilling, at a pH of about
12 by addition thereto of an alkaline-earth metal
A³ oxide, **in order to inhibit such deterioration** and
maintaining the drilling fluid during the course of
drilling, at a water loss of about 5 cc by addition thereto of
the amylaceous-emulsoid-colloid and of a colloidal clay.

Page 5 of the specification, after the last line and following the above amendment insert—

In the claims where reference is made to a pH of "about
12" it is understood that this includes a pH greater than
11.5 viz., between 11.5 and 12.5. Further, the expres-
A⁴ sion in the claims "alkaline-earth metal oxide", is to
include the corresponding alkaline-earth metal hydroxide. In the claims where reference is had to water loss, viz. "5 cc", this is to be understood to mean in accordance with A. P. I. standards; further, that the expression "5 cc" is used for the purpose of designating a low water loss.—

14 **Supplemental Oath.**

Dee A. Sikes and Jack H. Beesley, being duly sworn, depose and say as follows: That they are the applicants in the above entitled application. They further depose and say as to the following amendments made in said application:

Here follow the amendment dated March 27, 1947, filed April 1, 1947, supra.

17 Page 5 of the specification, after the last line and following the above amendment, insert—In the claims where reference is made to a pH of "about 12" it is understood that this includes a pH greater than 11.5 viz., between 11.5 and 12.5. Further, the expression in the claims

"alkaline-earth metal oxide", is to include the corresponding alkaline-earth metal hydroxide. In the claims where reference is had to water loss, viz., "5 cc.", this is to be understood to mean in accordance with A. P. I. standards; further, that the expression "5 cc." is used for the purpose of designating a low water loss.—

That the subject-matter of said amendment was a part of said invention, was made before they filed their original applications S. N. 489,890 and S. N. 653,716 for such invention; that they do not know and do not believe that the same was ever known or used before their invention or discovery thereof; or patented or described in any printed publication in any country before their invention or discovery thereof, or as to common subject-matter more than one year prior to their application, Serial No. 489,890, filed June 7, 1943, and as to subject-matter not common to the applications more than one year prior to this application; or in public use or on sale in the United States, as to common subject-matter more than one year prior to their application, Ser. No. 489,890, filed June 7, 1943, and as to subject-matter not common to the applications for more than one year prior to this application; that said invention has not
been patented in any country foreign to the United
18 States on an application filed by them or their legal
representatives or assigns more than twelve months
prior to this application; that no application for patent on said improvement has been filed by them or their legal representatives or assigns in any country foreign to the United States; that they have never abandoned the said invention; and that they duly executed the annexed Petition and Specification.

Dee A. Sikes,
Dee A. Sikes,

Jack H. Beesley.
Jack H. Beesley.

State of California }
County of Los Angeles } ss.

Said Dee A. Sikes sworn to and subscribed before me this 11th day of April, 1947.

A. D. West,
Notary Public.

My commission expires: July 27, 1948.

State of Oklahoma }
County of Tulsa } ss.

Said Jack H. Beesley sworn to and subscribed before me this 14th day of April, 1947.

My commission expires: August 4, 1947.

Ruth Talbert,
Notary Public.

19

St. Louis, Missouri
January 19, 1948

U. S. Patent Office
Received
Jan 26 1948
Division 64

Hon. Commissioner of Patents
Washington 25, D. C.

Sir:

Responsive to the Official Letter of July 25, 1947, the above-entitled application is hereby amended as follows:

Specification:

Page 2, line 23, before the period insert —; see Patent No. 2,417,307—.

Page 4, line 15, before the period insert—;

B^1 these may be added in order to bring or restore the viscosity and gel strength to the desired value—.

Claims:

Claim 11, line 3, after "colloid" (and before the comma) insert —which is subject to deterioration during the course of drilling—. Last line, before the period, insert —in order to inhibit such deterioration—.

Claim 12, line 3, after "colloid" (before the comma) insert —which is subject to deterioration during the course of drilling—. Line 6, after "oxide" (before the comma) insert —in order to inhibit such deterioration—.

Claim 13, line 2, after "fluid" (before the comma) insert —which is subject to amylaceous-emulsoid-colloid B^2 deterioration during the course of drilling—. Last line, before the period, insert —in order to inhibit deterioration of the amylaceous-emulsoid-colloid—.

20 Claim 14, line 3, after "colloid" (before the comma, first occurrence) insert —which is subject to deterioration during the course of drilling—. Last line, before the period, insert —in order to inhibit such deterioration—.

Claim 15, line 2, after "fluid" (before the comma, insert

B^3 —which is subject to amylaceous-emulsoid-colloid deterioration during the course of drilling—.

Line 7, cancel "and" and substitute therefor —in order to inhibit deterioration of the amylaceous-emulsion-colloid—.

Claim 16, line 4, after "colloid" (before the comma, first occurrence) insert —which is subject to deterioration during the course of drilling—. Last line, before the period, insert

B^4 —in order to inhibit deterioration of the amylaceous-emulsoid-colloid and to counteract the deleterious calcium compounds—.

Claim 17, line 3, after "colloid" (before the comma, first occurrence) insert —which is subject to deterioration during the course of drilling—. Line 6, after "oxide", (before the comma) insert —in order to inhibit such deterioration—.

21 St. Louis, Missouri
February 2, 1949.

Filed Feb. 8, 1949.

Hon. Commissioner of Patents
Washington, D. C.

Sir:

I hereby appeal from the action of the Examiner, dated August 27, 1948, finally rejecting all of the claims, namely, 11 through 17, in the above-entitled application. This appeal is taken for the reason that the Examiner erred:

(1) In finally rejecting the claims.

(2) In rejecting the claims on the references and for the reasons of record.

(3) In requiring that the expression "continuation-in-part" instead of "continuation . . . as to common subject matter" be used.

(4) In requiring cancellation of the amendment of April 1, 1947, to pages 3 and 5 and the amendment of January 22, 1948, to page 4 be cancelled.

(5) In requiring cancellation of the definition "alkaline earth oxide" on page 5 of the specification be cancelled.

(6) In rejecting the claims as being indefinite and vague by the use of the term "alkaline earth oxide" as defined in the specification.

(7) In rejecting claim 16 as indefinite.

(8) In rejecting claim 17 as involving new matter.

An oral hearing is respectfully requested, and the appeal fee of $15.00 is filed herewith.

Respectfully submitted,

Bruninga & Sutherland,
By John H. Bruninga,
Attorneys for Applicants.

1-ken

22 **AFFIDAVIT.**

Filed May 19, 1950.

Delmar H. Larsen, being duly sworn, deposes and states as follows:

I am Associate Director of Research of the Baroid Sales Division of the National Lead Company and have been employed by this company in a research capacity, among others, since 1936. I am a graduate of the California Institute of Technology and a Registered Professional Engineer in the Field of Petroleum Engineering in the State of California.

At the present time and for at least the past six years, the Baroid Sales Division has been the largest supplier of starch for use in drilling mud in the United States. I have been associated with the development and sale and field use of the starch marketed by the Baroid Division from the beginning and I am familiar with the present day methods of use.

At least one-half of the starch used in drilling muds in the United States at the present time is used with lime present in the mud, the lime having been deliberately added as quicklime or more commonly as slaked lime, and sufficient being present so that at least traces of calcium ion are found in the filtrate from the mud. Such muds are known as "lime-starch muds" and are in wide use.

Many muds of this type contain tanstuffs, such as quebracho extract, in addition to lime and starch, but in many cases the mud consists of lime, clay, starch and water. This is particularly the case in California, where at least one-half of the starch used is employed in lime muds of the type described, but substantially free of other organic additives. During the course of drilling, caustic soda and soda ash may be added but a slight excess of lime is carried at all times. During the year 1949 the Baroid Sales Division sold in excess of 636 tons of their processed starch, 23 "Impermex," for use in drilling muds in California, so that upon the basis of my estimate of one-half usage in lime muds, this amounts to more than 318 tons used in California alone in lime-starch mud systems.

Delmar H. Larsen.

Subscribed and sworn to before me this 16th day of May, 1950.

A. D. West,
Notary Public in and for the County
of Los Angeles, State of
California.

My Commission Expires July 27, 1952.

24

AFFIDAVIT.

Filed June 2, 1950.

Richard E. Offeman, being duly sworn, deposes and states as follows:

I am a graduate of the California Institute of Technology with the degrees of B. S. in Chemical Engineering and M. S. in Aerological Engineering, and have been employed in a technical capacity by the Baroid Sales Division of the National Lead Company since 1937, except for three and one-half years of service with the Navy during the recent war. I have been Manager of the Los Angeles laboratories of the Baroid Sales Division since February 20, 1947.

I have recently had tests carried out under my direction of the gelatinizing power of caustic soda and caustic lime solutions of cornstarch. The tests were made in the following manner: 3 grams of cornstarch (Kingsford's) were added to 100 cc. of distilled water and stirred until free of lumps, whereupon the quantity of alkaline material specified below was added with continuous stirring for about one minute. Viscosities of the suspensions were measured with a Stormer viscosimeter operated at 600 r. p. m. and the pH was measured with a Beckman glass electrode pH meter, whereupon the suspensions were allowed to remain in beakers and their appearance noted immediately after the preparation, after 30 minutes standing and after 18 hours standing. The results are tabulated as follows:

Additive	Grams*	pH	Viscosity	Initial Clarity	Settling After 30 min.	Settling After 18 hrs.	Appearance of Liquid After 18 hrs.
None	..	5.9	1.0	Milky	Settled out	Settled out	Clear
NaOH	0.1	12.0	1.3	Milky	" "	" "	"
"	0.5	12.5	2.6	Milky	" "	" "	Very slightly turbid.
"	1.0	12.6	39.4	Translucent	No settling	No settling	All translucent
"	2.0	12.7	15.4	Translucent	" "	" "	" "
Ca(OH)2	0.1	12.0	1.0	Milky	Settled out	Settled out	Clear
"	0.5	12.4	1.0	Milky	" "	" "	"
"	1.0	12.4	1.1	Milky	" "	" "	"
"	2.0	12.4	1.1	Milky	" "	" "	"

---

* Grams additive added to 100 cc. distilled water containing 3.0 grams cornstarch.

25 From the clarity of the suspensions containing respectively 1 and 2 grams of caustic soda, and the fact that the viscosity was considerably in excess of that of water, and moreover, the fact that there was no settling of any kind, it is clear that the gelatinization of the starch is complete in these two suspensions. Very slight incipient gelatinization is apparent in the suspension containing 0.5 grams caustic soda, as judged by the viscosity and slight turbidity on standing; but the bulk of the starch remain-

ing ungelatinized was shown by its settling out. There was no gelatinization whatsoever in the sample containing 0.1 gram caustic soda as shown by the fact that the starch settled out completely leaving a clear supernatant liquid. On the other hand there was no gelatinization whatever in the samples containing calcium hydroxide. This was shown by the fact that the viscosity did not increase substantially over that of water, and there was complete settling of the starch upon standing, leaving a clear supernatant liquid. The pH of the suspensions containing, respectively, 1 and 2 grams of calcium hydroxide did not rise above the pH of the suspension containing 0.5 gram of calcium hydroxide, because in all three of these suspensions the lime was present in excess of the solubility of lime in water.

I conclude, therefore, that calcium hydroxide is not a gelatinizing agent for cornstarch.

Further deponent sayeth not.

Richard E. Offeman.

Subscribed and sworn to before me this 19th day of May, 1950.

A. D. West,
Notary Public, in and for the County
of Los Angeles, State of
California.

My Commission Expires July 27, 1952.

Pages 97 to 121, both inclusive, omitted here.

DEFENDANT'S EXHIBIT 1-D.

Examiner's Statement.

(July 13, 1949.)

This is an appeal from the final rejection of claims 11 to 17 inclusive, all of the claims in the case.

The claims appealed are as follows:

(The claims are set out in Plaintiff's Exhibit 1, pp. 86, etc., supra.)

The art relied upon in the rejection of the claims is as follows:

Cannon	March 1, 1938	2,109,858

Role of Clay and Other Materials in Oil-Well Drilling Fluids, by George Stern—Bulletin No. R. I. 3556—Bureau of Mines—February 1941—Page 77.

The subject matter of this application which is being appealed relates to a method of drilling wells through formations by maintaining an aqueous mud-laden well drilling fluid containing an amylaceous-emulsoid-colloid which is subject to deterioration during the drilling operation at a pH of about 12 by adding thereto an alkaline earth oxide to prevent the deterioration of the colloid and further maintaining the drilling fluid during the course of drilling at a low water loss, by means of the amylaceous emulsoid and colloidal clay.

The titling of this application as a continuation of application Serial No. 489,890 has been objected to on the ground that this application contains additional descriptive matter not contained in Serial No. 489,890. It is the Examiner's position for an application to be a continuation of an earlier application of the same party it must not contain any additional matter as such an application like a divisional application is given the date of the earlier application as to all of the subject matter. Due to the inclusion of additional subject matter, applicants are only entitled to the benefit of their earlier application as to a portion thereto. It is practice of the Office to title such applications as **continuation-in-part.**

Applicants have been required to cancel from the paragraph added on page 3 and in the sentence added on page 5 by the amendment of April 1, 1947, that matter that describes the addition of the colloidal clay to the drilling mud for the purpose of maintaining the viscosity of the drilling mud as involving new matter as the original specification made no reference to this function for the colloidal clay. This modification of the viscosity of the mud by the addition of the colloidal clay may be considered an inherent property of many clays but it cannot be stated that it would act in the same way in applicants' mud especially since it is an afterthought and relied upon by applicants as a distinction.

Applicants have also been required to cancel the insertion made in line 15 on page 4 of the specification by the amendment of January 22, 1948, on the ground that it involves new matter for the same reason stated above.

Applicants have also been required to cancel the definition for alkaline earth oxide inserted after the last line on page 5 of the specification by the amendment filed April 1, 1947, as being improper due to its inaccuracy. It is the Examiner's position that an alkaline earth oxide (CaO) cannot accurately be stated that it includes the corresponding alkaline earth hydroxide ($Ca(OH)_2$). The hydroxide is the oxide that has been hydrated. There appears to be no justification for altering the natural meaning of a material. The claims in the case were rejected as being indefinite and confusing due to the definition inserted in the specification for the meaning given to the term "alkaline earth oxide" in the claims.

Claim 16 was rejected as being indefinite as to the kind of deleterious calcium compounds present in the formation during which drilling is carried out. The specification is not clear. If these substances are removed by adding to the drilling mud sufficient sodium carbonate to precipitate all calcium ions, all of the alkaline earth oxide or hydroxides would be precipitated. The term "an alkali including an alkali metal carbonate" in this claim is also a source of indefiniteness. It is not clear from the disclosure which substances are to be included within the meaning of this phrase.

Claim 17 has been rejected as being based upon new matter in including the step of maintaining the drilling fluid at a water loss during the course of drilling of about 5 cc by the addition thereto of the amylaceous-emulsoid-colloid and of a colloidal clay.

Applicants filed a supplemental oath on April 16, 1947, in order to support the amendments made in the specification and claims. This oath, however, cannot be used to justify the inclusions of new matter in the specification and claims.

The claims were rejected as being unpatentable over the disclosure in the patent to Cannon 2,109,858. This patent has a disclosure of having admixed with the drilling mud a calcium oxide in an amount sufficient to render the drilling mud highly alkaline. Note lines 48 to 55, inclusive, of column 2 of page 1 of this patent for this teaching. Also there is admixed with the drilling mud a polyhydroxy organic compound, such as, starch. Note line 4 of column 1 of page 2 of this patent. It is the Examiner's position that the amount of lime used would inherently bring the mud to a pH of about 12. If there is any doubt as to inherent property of the line in the drilling mud of this patent of maintaining the drilling mud in the vicinity of a pH of 12 to prevent the deterioration of the starch in the drilling mud there would be no invention involved in adjusting the amount of the lime used to accomplish this purpose in view of the teaching on page 77 of the Bureau of Mines Bulletin of using sufficient sodium hydroxide with the starch in the drilling mud to produce a pH of about 12.

It is respectfully submitted that the final rejection of the claims be sustained.

Examiner.

DEFENDANT'S EXHIBIT 1-E.

Examiner's Reply to Appellants' Brief.

(June 15, 1950.)

EXAMINER'S STATEMENT.

In considering applicants' brief and affidavit filed May 19, 1950, the following comments are listed:

In respect to the patent to Cannon, it would appear from applicants' brief that this patent does not have the disclosure of lime and starch admixed with a drilling mud but caustic soda admixed with quebracho extract in a drilling mud. To this the Examiner does not agree. In view of this patent, it should be noted that in the last paragraph of column 2 of page 1 extended over on page 2, there is a disclosure of treating a drilling fluid with sufficient alkaline material to render the drilling fluid distinctly or highly alkaline. One of the alkaline materials used is lime (line 54, column 2, page 1). This alkaline material used in the drilling fluid is in the presence of an organic compound containing three or more hydroxy groups, such as, starch. Although this patent does not disclose a specific composition of a drilling fluid containing starch and lime, the latter in an amount to raise the pH to about 12, it does have specific examples of caustic soda admixed with an organic compound containing three or more hydroxyl groups, such as, quebracho extract in proportions to give a composition having a pH around about 12. The disclosure of this patent makes lime the equivalent of caustic soda and starch the equivalent of quebracho extract.

The affidavit submitted by Larsen along with their brief is not convincing to establish patentability of the claims over the art. The facts set out in the affidavit deal with the commercial success of the drilling mud being claimed and not with showing that the drilling mud has new and unexpected properties over the drilling mud of the prior art, especially that disclosed in the patent to Cannon.

The supplemental affidavit by Richard E. Offeman submitted May 31, 1950 has been considered but is not effective in persuading the Examiner in changing his position. The affidavit merely shows the differences in the action between caustic soda and lime in a drilling mud containing starch which is not the point in issue. The patent to Cannon discloses both CaO and starch in drilling muds and the Examiner has not questioned the equivalency of sodium hydroxide and lime.

It is respectfully submitted that the final rejection of the claims be sustained.

Examiner, Div. 64.

DEFENDANTS' EXHIBIT 1-F.

Decision of Board of Appeals.

(July 18, 1950.)

Appellants appealed from the final rejection of claims 11 to 17, inclusive, these being all of the claims in the application.

In the brief, appellants indicate that they desire to have the appeal dismissed as to claim 16. We will therefore only consider the appeal as to claims 11 to 15, inclusive, and claim 17.

Claim 11 is representative of the claims on appeal and is reproduced herebelow:

11. In the art of drilling wells through formations by the employment of an aqueous mud-laden well-drilling fluid containing an amylaceous emulsoid colloid which is subject to deterioration during the course of drilling, the process, comprising, maintaining such a drilling fluid, during the course of drilling, at a pH of about 12 by addition thereto of an alkaline-earth metal oxide in order to inhibit such deterioration.

The references relied upon are:

Cannon	2,109,858	March 1, 1938

Role of Clay and Other Materials in Oil-Well Drilling Fluids by George Stern—Bulletin No. R. I. 3556—Bureau of Mines—February 1941—Page 77.

To which we add:

Starch and Its Derivatives—J. A. Radley (2d Edition), pages 264 and 265, published 1944 by D. Van Nostrand Co. Inc. 250 Fourth Ave. New York, N. Y.

The Examiner has objected to the designation of this application as a "continuation" of application 489,890. It is noted that appellants termed this application "a continuation—as to common subject matter" which in more conventional Patent Office language should be—a continuation in part—But this objection is not appealable and we will not rule on the same.

The disclosure herein relates to well drilling, particularly to the treatment of the "mud" used in deep oil well drilling processes.

In such drilling operations a hollow pipe string is used having a rotary drilling bit at its lower end, the same being provided with perforations extending from outside the bit to the interior of the hollow pipe. The bit is larger in diameter than the pipe allowing for rotation of the pipe string without contacting the wall of the well. To seal off the wall of the well and prevent seepage into the well or breakdown of the wall, and to carry off heavy cuttings, a mud, as clay-mud, is pumped down through the pipe, out through the perforations in the bit and up around the pipe and into the tank where the mud is screened. From the tank the screened mud is again pumped into the pipe. The mud not only helps carry up the well diggings but also thinly lines the wall of the well.

To avoid seepage of water from the mud into the surrounding oil bearing strata, the prior art discloses the use of gelatinized starch added in sufficient quantity to the mud to form with it a drilling fluid of sufficient viscosity so that when it is washed against the wall of the well in the upward travel of the fluid, some of the fluid mixture will thinly deposit on the wall and thereafter very little water will flow through the lining. The prior art also has recognized that the starch is subject to deterioration, as by bacterial or enzymic action, and Stern proposed the addition of salt to the mud mixture to inhibit this deterioration.

Appellants alleged to have discovered that such deterioration can be inhibited by initially making and subsequently maintaining the starch charged fluid at high alkalinity, specifically at a pH of 12.

In the above referred to prior application appellants made claim to the broad idea of establishing and maintaining a pH of 12 of the drilling fluid, no particular alkali being claimed although the following were enumerated in that application: caustic soda, caustic potash, caustic lithium, caustic ammonia. Further, the appellants contemplated the use of lime ($Ca(OH)_2$), particularly in the form of soda lime ($NaOH + CaO$) as a substitute for the caustic materials.

With respect to the starch, appellants stated in the earlier application that the starch utilized in deep well drilling operation need not have been previously gelatinized since due to the high temperature (180°F) existing at the bottom of such a well, the starch will of itself become gelatinized. We interject here that obviously, at a pH of 12—which appears to be the alkalinity of the drilling fluid in Cannon—there should be no difficulty in attaining the gelatinized state at the specified temperature.

We held in that application that the claims were unpatentable over the same references as are relied upon in the rejection of the claims in this application.

In brief, we held that Cannon did disclose the use of a drilling mud which was maintained at a pH of about 12 by the use of an alkali and that the patentee did use starch as an ingredient of the mud and that deterioration of the starch would be inhibited regardless of whether or not Cannon recognized that fact.

The claims in this application differ from the claims in the other application in the limitation that the alkalinity of the mud is established and maintained by the use of an alkaline-earth-metal oxide. In the earlier application the only such oxide set forth in the specification is calcium oxide in the form of soda lime. In this application, appellants included: the oxides of magnesium, barium and strontium in addition to that of calcium. This application, as stated, by appellants, in effect, is a continuation-in-part of the earlier application.

Appellants argue that the starch used in Cannon is not gelatinized. There is every reason to believe that the starch in Cannon is gelatinized due to the action of the lime, particularly if heat be present at the bottom of the well; that alkalies will gelatinize starch without the addition of heat seems to be accepted as a fact. See, for example, Radley, pages 264 and 265, which states that starch will undergo gelatinization with alkalies at room temperatures. Appellants present no proof to the contrary.

Since the Cannon patent discloses the use of lime as an alkali in the mud-starch-alkali drilling fluid, it is considered that the drilling fluid in Cannon substantially anticipates the claims on appeal. As in the previous case we hold there is no invention in maintaining an established condition.

The Examiner objects to the introduction into the specification at page 4, line 15, and page 5, line 29, statements to the effect that the addition of colloidal clay to the mud mixture would affect the viscosity of the mixture, alleging that this is new matter. We are of the opinion that where, as here, materials have an inherent property of acting as stated, there is no reason to deny appellants the right to state that such a property exists. Obviously the addition of a colloidal clay to a mud mixture unless it were exactly of the same viscosity must affect the viscosity of the mixture. At page 4, lines 14 and 15, appellants had originally stated that the original clay may have been bentonite, which is colloidal clay, and at page 4, lines 29 and 30, appellants originally stated they may add this clay as needed to compensate for that which drops out. We disagree with the Examiner as to this matter, objected to by him, being improperly introduced into the application. The insert to page 3, objected to by the Examiner does not refer to any change in viscosity and is unobjectionable.

We are in agreement with the Examiner that appellants' statement added by Amendment to the end of the specification as to how the claims are to be interpreted is improper and should be deleted. In this connection attention is directed to Ex parte Champ 1905, C. D. 54.

His rejection of the claims on the ground that this amendment renders the claims indefinite is believed to be proper.

Claim 17 states that the colloidal clay is added to the mud (as well as starch) to maintain the mud at a water loss of about 5cc. We agree with the Examiner that there is no basis for this in the specification as filed and that the claim includes new matter. We therefore agree with the Examiner that this claim is not patentable.

The appeal is dismissed as to claim 16.

The decision of the Examiner is affirmed.

In event of appeal attention is directed to In re Boyce, 32 CCPA 718, 144 F. (2d) 896, 1944 C. D. 609, 568 O. G. 568, 63 USPQ 80, in regard to specifically including in the appeal notice all grounds of rejection in the Examiner's Statement not expressly overruled by the Board.

S. Wolffe
Examiner-in-Chief

M. I. Rosa
Examiner-in-Chief
(Acting)
Michael Hertz
Examiner-in-Chief
(Acting)

Board of Appeals

DEFENDANTS' EXHIBIT 1-F.

On Petition for Reconsideration.

(September 26, 1950.)

This is a petition for reconsideration of the decision of the Board of Appeals dated July 18, 1950.

We have carefully considered petitioners' remarks and arguments presented in the petition, but we are not persuaded that we erred in the decision reached by us.

The petition has been considered but is denied in respect to making any change in our decision.

S. Wolffe
Examiner-in-Chief
M. C. Rosa
Examiner-in-Chief
(Acting)
Michael Hertz
Examiner-in-Chief
(Acting)
Board of Appeals

September 26, 1950.

Bruninga & Sutherland,
1004 Market Street,
St. Louis, Missouri.

DEFENDANT'S EXHIBIT 2.

Pending Application of
Dee A. Sikes and Jack H. Beesley,
Filed June 7, 1943, Serial Number 489,890,
for
Improvement in Treatment of Well Drilling Fluids.

This invention relates to well drilling fluids, as employed in the drilling (including coring) of wells, viz., oil and gas wells, whether drilled by the rotary or cable tool systems. This invention is applicable to fluids whose aqueous phases are fresh and salt water and to cases where salt or salt water are encountered. This invention is also applicable where the drilling fluid is or becomes contaminated by other soluble or partly soluble substances which have a deflocculating effect on clay or other materials in the fluid.

This invention is an improvement on the Harth patent 1,991,637, granted February 19th, 1935. This Harth patent discloses the employment in drilling fluids of concentrated colloidal materials suitable and adapted for the particular dispersion medium of the fluid, and more particularly emulsoid colloids, including starch. It is obvious, of course, that in order for the starch to act as an emulsoid colloid, it should be in a gelatinized form. Starches may, in general, be gelatinized as early disclosed in the Marsden patent 376,445, granted January 17, 1888; this is attained by boiling the starch in water with or without an alkali, such as, caustic soda. An example of this is wheat paste, prepared from wheat flour, and which has long been used by paper-hangers. Moreover, starch has long been gelatinized by housewives when employed in cooking for the making of puddings, gravies, etc. In some cases preheating of starch for employment in a well-drilling fluid is not even necessary; because the temperature at the bottom of a deep well is frequently in the neighborhood of 180° F. and above; accordingly even dry ungelatinized starch, when added to a drilling fluid at the top of such a well, will become gelatinized at the bottom of the well. In shallow wells, however, where the temperature is not sufficiently high the practice has been to gelatinize or paste the starch before addition to the drilling fluid.

A form of starch which is an emulsoid colloid is a pregelatinized starch prepared by cooking the starch with water and drying it; it may then be comminuted for addition to the drilling fluid in dry form; an example is cold water laundry starch which gelatinizes in cold water. Thin-boiling starch (prepared, for example, by mineral acid treatment) gelatinized by cooking with water, is useful for this purpose. All such starches are emulsoid colloids and more specifically are amylaceous or starchy colloids. Suitable for the practice of this invention are the gelatinized starches of corn, potato, tapioca, rice, arrowroot, sago palm, wheat, and the by-products of flour such as ship-stuff, shorts and middlings, etc.

Starch has been employed in well drilling fluids in which the aqueous phase was either fresh or salt water. In such cases it has been found that starch reduces the water loss markedly as compared to cases where clays, including bentonite and fuller's earth, were used as the fluid bases. In a drilling fluid, however, starch is subject to deterioration, apparently because of the presence of bacteria, yeasts or molds, or enzymes derived therefrom. These agents apparently split or break down the starch, sometimes resulting in a condition of fermentation or souring of the drilling fluid. This deterioration of the starch may disadvantageously affect the desired characteristics of the fluid; for water-loss increases rapidly as fermentation progresses, the fluid viscosity is disadvantageously affected, and a condition analogous to "gas cutting" may take place.

While in salt water of comparatively high salt content (over 15%), deterioration of the starch and fermentation are often retarded, and while common salt may be added to fresh water drilling fluids, this deterioration and fermentation are not effectively inhibited; moreover, the latter procedure requires large quantities of salt and is, therefore, expensive, while the brine has a corrosive effect upon the equipment and has an effect of flocculating the cheaper clay colloids employed. In drilling fluids employing starch, in an aqueous phase of fresh water, or salt water, particularly of lower salt contents, in the course of time, deterioration of the starch may, therefore, so progress as to require frequent additions of starch, and this can only be continued to a limited extent; for deterioration will sometimes proceed faster than the starch is added. What apparently takes place, is that the starch is converted to dextrines, sugars or other products, which are not only ineffective as sealing mediums, but dissolve in the aqueous phase and bring about a condition of fermentation. While many preservatives other than salt have been suggested, these have not been found to be entirely satisfactory and moreover are liable themselves to disadvantageously affect the desired properties of a well drilling fluid.

Some of the objects of this invention, therefore, are to provide a treatment of well drilling fluids with starch or other amylaceous or starchy colloids, and a resulting well drilling fluid, whereby the above noted effects are overcome.

Other objects are to provide a process and fluid which attain a substantial well-seal of low water loss at an operable viscosity.

Further objects will appear from the detail description in which will be set forth a number of illustrative embodiments of this invention; it is to be understood, however, that this invention is susceptible of various other embodiments within the scope of the appended claims.

In the drawing, the figures are diagrams illustrating the effects and results of this invention. Figure 1 shows the results obtained when starch is added to a drilling mud consisting of a good average clay used for this purpose mixed with water, when the pH of the mud is brought to 12 prior to the addition of the starch. In using such a mud as the drilling fluid in a well sufficient alkali should be added from time to time to prevent the pH falling below this figure. The specific gravity of the drilling fluid was 1.2, i. e., it weighed 10 pounds per gallon (75 pounds per cubic foot, 420 pounds per barrel of 42 gallons). The drilling fluid in Figure 2 is substantially the same as that of Figure 1 with the exception that it contains salt ($NaCl$). The drilling fluid of Figure 3 is substantially the same as that of Figure 1 with the exception that the aqueous phase is fresh water saturated with calcium sulphate. The curves for muds of the type shown in Figure 2 are approximately the same regardless of the percentage of sodium chloride contained in the mud and the curves for the muds of the type of Figure 3 are approximately the same regardless of the percentage of calcium sulphate contained in the mud. Curves for muds containing magnesium chloride and calcium chloride vary slightly depending upon the quantity of contaminating substances present in the mud.

The starch employed in each case was the thin boiling starch previously described. The pH of the drilling fluid was maintained at about 12 by caustic soda (NaOH). When a drilling fluid employing bentonite or fuller's earth is used, the behavior is generally the same as shown.

We have discovered that when the alkalinity of a drilling fluid is brought to and maintained at a sufficiently high pH, then such a fluid can have incorporated with it, starch or other amylaceous colloids, without attendant deterioration of the colloid or fermentation of the fluid. We have also found that under such conditions, starch can be added to a much greater percentage than heretofore deemed possible, and that water-loss can be reduced to a very low point and indeed practically eliminated. When starch is added to such a drilling fluid, the viscosity first actually decreases with the initial addition of starch to a certain point, and then slowly rises; the viscosity may, however, be controlled by the addition of clay colloids, such as bentonite, etc., and by the addition of viscosity-reducing agents, such as caustic and tannin or polyphosphates. In accordance with this invention, when the drilling fluid is at a pH of 12, sufficient of a starchy colloid can be added to attain a substantial wall-seal of low water loss and at an operable viscosity.

We have found that when the alkalinity of a well drilling fluid is established and thereafter maintained at a pH of about 12, then starch may be incorporated in such a fluid, and it will continue to function as a sealing medium without deterioration or attendant fermentation. Moreover, we have found, that under such conditions, the water loss will decrease with additions of starch, to a point where it approaches zero water loss,* and all without deterioration or fermentation, so that the low water loss is not only attained but is maintained. The above is not only true of a drilling fluid whose aqueous phase is fresh water, but salt water as well, and to a fluid whose solid phase is clay, bentonite or fuller's earth. This is illustrated in the drawing, which is self-explanatory.

The reason for the advantageous effects, brought about by maintaining a drilling fluid at the above noted high pH, is believed to be due to the fact that the starch-splitting enzymes are rendered innocuous at a pH of about 12. While the bacteria are probably killed at a pH of somewhat below 12, this is not sufficient, for the enzymes apparently act as catalysts and may still remain effective. At a pH of about 12, the results seem to show that, in a drilling fluid, the enzymes are apparently rendered incapable of bringing about deterioration of the starch or fermentation of the drilling fluid. The pH may be slightly below 12, thus a pH of 11.7 is in many cases sufficient. The pH may also be above 12, although that requires rapidly increasing quantities of the alkali as the pH is increased, as shown in the drawing. We have, however, found that generally the pH should not be above 13.3, because it appears that above that point the starch tends to begin to become less effective.

The drilling fluid may be brought to the desired pH by any suitable alkali, as by the addition of caustic soda, caustic potash, caustic lithium, caustic ammonia, etc. Of these caustic soda is the most economical to employ. However, even lime ($Ca(OH)_2$) may be employed, particularly as soda lime, although lime is not as effective as caustic soda and its tendency is one moreover to flocculate the drilling fluid before starch is added. Soda ash (sodium carbonate—$NaCO_3$) may also be employed in connection with a caustic.

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* Viz. the water loss in 30 minutes as determined in accordance with the American Petroleum Institute's "Standard Field Procedure for Testing Drilling Fluids".

While the drilling fluid may be brought to the desired pH at any time, the better and more economical procedure is to attain a pH of about 12 before the addition of the colloid; for in that way not only will the starchy colloid be better utilized, but starch deterioration and attendant fermentation will be initially inhibited, so that less of the alkali and of the colloid will be required to give the desired result. A deteriorated drilling fluid may, however, be brought to the desired condition to stop and overcome fermentation, by the addition of the alkali, although in that case much more of the alkali and starch will be required. In any case the pH may thereafter be maintained by the addition of the alkali thereto. The alkali and starch may be added, preferably at the intake, although one or both may be added in the settling ditch and circulated.

The amount of alkali to be added initially, or later as the drilling proceeds, will depend upon the conditions encountered and the character of the fluid employed and of the formation being drilled. This will be clear when we consider that an alkali will also act upon salts contained in the aqueous and solid phases of the fluid and of the formation. While, therefore, no definite percentages can be prescribed, the amounts required may be readily determined. The pH of the fluid may be readily tested at any time to determine its condition. A number of pH meters and indicators are available. A suitable indicator is a solution of trinitrotoluene (TNT) in methyl alcohol which, at a pH of about 12, gives a dark red color when added to a drilling fluid containing clay, bentonite or fuller's earth. Any other suitable indicator such as Beckman pH meter may be employed. It will, therefore, be understood that where a pH of about 12 is designated, it will include determination by the various means described; generally stated it will include a pH which will inhibit deterioration of a starchy colloid in a well drilling fluid and prevent fermentation of the fluid.

With a drilling mud maintained at the pH of about 12, a colloid employed, such as starch, as heretofore described, is added until the water loss is reduced to the desired minimum, which may be determined by testing the fluid initially and periodically by a filter press of which a number are available.* The results of such a procedure are shown in the drawing, from which it will be seen that by this method, with the addition of starch (to a fluid maintained at a pH of about 12) the water loss first decreases rapidly and then more slowly. This drawing, however, shows generally the amount required to attain a desired water loss. In accordance with this invention, starch to the amount exceeding 3% and even to 6% of the weight of the drilling fluid may be readily added when the fluid is maintained at a pH of about 12.

In accordance with this invention a water loss approaching zero may be attained, and in practice a water loss of 0.5 cc (30 minutes) has been attained, and a water loss below 3 cc (30 minutes) is readily attained. As will be seen from the drawing, the amount of starch required to secure resultant decreases in water loss, increases rapidly below 10 cc, so that economic considerations govern the end to be attained. In general, however, the attainments of a water loss of less than 5 cc is highly desirable. A low water loss is very important in modern well drilling, even where the aqueous phase of the drilling fluid is fresh water. Thus in coring, a substantially zero water loss enables the taking of a core, which will accurately present the oil and gas content of the formation. In drilling through heaving shale, such a low water-loss drilling fluid inhibits hydration of the shale. In general the low water-loss drilling fluid described will reduce passage of water to a producing formation to practically zero, will prevent flooding of a producing formation and form a thin filter cake and so avoid sticking of the drill pipe.

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* See Drilling Mud of May, 1940, pp. 4 etc. describing the above procedures.

Because of the fact that amylaceous colloids, such as starch, etc. are particularly effective when employed with a high pH, these may be employed in the treatment of cement-cut muds; for the presence of the cement will not now be harmful but beneficial, because of the elevation of the pH by the cement. In such a case the additional starch will actually result in the thinning of the mud for the reason that, as noted above, the first addition of starch results in a progressive decrease of viscosity when added to an already alkaline drilling fluid, followed by a rise in the viscosity with the successive additions of starch. In such a case the desired results can be obtained by adding additional alkali in order to attain a pH of about 12. A cement-cut mud may, therefore, be corrected by the addition of starch, where required, and of additional alkali. Moreover, when the above high pH mud containing starch is employed while drilling through cement, the cement will not disadvantageously affect the fluid.

Where gypsum or anhydrite is encountered in drilling, the presence of the alkali will convert the calcium sulfate to calcium hydroxide and sodium sulfate as follows:

$$CaSO_4 + 2NaOH \text{ —— } Ca\,(OH)_2 + Na_2SO_4$$

In the resulting compounds the lime is useful in maintaining alkalinity, although slightly decreased as compared to caustic soda. This invention is also useful where the drilling fluid contains or entrains sulphides, without or with lime or cement or all of them.

It sometimes happens that by performing the process in the manner described by the employment of starch in a drilling mud of high pH, there will be a reduction in viscosity and/or gel strength. In such cases, these can, if necessary, be restored or brought to the desired value by the addition of bentonite or fuller's earth or a good clay. Additions of sodium carbonate and sodium bicarbonate are, in many cases, also useful to improve the drilling fluid.

In general, the procedure employed will depend upon circumstances. Where the drilling fluid is one in which the solid phase is clay, bentonite or fuller's earth, with or without a weighting material, such as barytes, the preferred procedure is one to first add an alkali to establish a pH of about 12. Starch is then added until the desired low water-loss is attained, with addition of alkali when necessary to maintain the pH. Where necessary a clay colloid is added to secure the desired viscosity and gel strength, and where necessary the viscosity is further controlled by the addition of caustic and tannin or of a polyphosphate. There should, of course, be observation of the pH and water loss as the drilling proceeds, with additions of alkali and starch when required to maintain the pH at about 12 and to maintain the low water-loss.

The type of viscosity of fluids or muds containing an appreciable quantity of starch is quite different from the type of viscosity encountered in other drilling fluids. In high pH muds to which starch is added the viscosity approaches more nearly a true viscosity, whereas, the so-called viscosity of ordinary drilling fluids is primarily a measure of the shear. High pH starch fluids having a Stormer viscosity of 120 centipoises are still very thin, fluid and readily pumpable, whereas, with ordinary drilling fluids the upper allowable limit is a Stormer viscosity of about 50 centipoises. The difference in viscosity is more noticeable even on the Marsh funnel test than it is on the Stormer viscometer. For example, the upper limit of viscosity on an ordinary clay drilling fluid is perhaps 60 seconds on the funnel viscometer, whereas, a starch fluid having a viscosity of 90 centipoises is still almost as fluid as water. The important difference between the high pH starch fluid and the ordinary clay fluid is the starch fluids have a very low initial gel. Sodium bicarbonate can be added to high pH starch fluids to increase the initial gel strength if necessary. This increase in gel strength is obtained with a very slight increase in viscosity. To increase the viscosity of high pH starch fluids, fuller's earth can be added. This is also true of salt water fluids. When the high pH of starch fluids is obtained by the use of caustic soda the initial gel strength of the original fluid is substantially lowered.

While this invention is particularly applicable to the drilling of wells by the rotary system of drilling employing a circulating drilling fluid, it is also applicable to cable tool drilling. In both cases, a low water-loss is desirable, not only while drilling, but while coring. This invention is applicable to the drilling of wells or bore-holes generally, including the drilling of test holes preliminarily for exploration. This invention is applicable not only to drilling fluids in which the aqueous phase is fresh water but salt water and even when the salt content exceeds 15%.

Having thus described the invention, what is claimed is:

1. In the art of drilling wells by the employment of an aqueous drilling fluid, the process comprising, adding to such a fluid, a starchy colloid, while the fluid is maintained at a pH of about 12.

2. In the art of drilling wells by the employment of an aqueous drilling fluid, the process comprising, bringing such a fluid to a pH of about 12 and thereafter adding a starchy colloid to said fluid.

3. In the art of drilling wells by the employment of an aqueous drilling fluid, the process comprising, adding to such a fluid, while maintained at a pH of about 12, sufficient of a starchy colloid to attain a substantial wall-seal of low water loss and at an operable well-drilling viscosity.

4. In the art of drilling wells by the employment of an aqueous drilling fluid, the process comprising, bringing such a fluid to a pH of about 12 and adding to such a fluid, sufficient of a starchy colloid to attain a substantial wall-seal of low water loss and at an operable well-drilling viscosity.

5. In the art of drilling wells by the employment of an aqueous drilling fluid, the process comprising, bringing such a fluid to a pH of about 12, adding a starchy colloid to said fluid and thereafter maintaining said fluid at such pH.

6. In the art of drilling wells by the employment of an aqueous drilling fluid, the process comprising, adding to such a fluid, while maintained at a pH of about 12, a starchy colloid in an amount sufficient to attain a water-loss of less than 5 cc.

7. In the art of drilling wells by the employment of an aqueous drilling fluid, the process comprising, bringing such a fluid to a pH of about 12 and adding a starchy colloid to said fluid in an amount sufficient to attain a water-loss of less than 5 c.c.

8. In the art of drilling wells by the employment of an aqueous drilling fluid, the process comprising, bringing such a fluid to a pH of about 12, adding a starchy colloid to said fluid in an amount sufficient to attain a water loss of less than 5 c.c., and thereafter adding an alkali and a starchy colloid, when required, in amounts sufficient to maintain said pH and said water loss.

9. In the art of drilling wells by the employment of an aqueous drilling fluid the process comprising, adding to such a fluid, while maintained at a pH of about 12, from 3% to 6% of a starchy colloid as related to the weight of the fluid.

10. In the art of drilling wells by the employment of an aqueous drilling fluid the process comprising, bringing

such a fluid to a pH of about 12 and thereafter adding a starchy colloid to said fluid in an amount from 3% to 6% as related to the weight of the fluid.

11. An aqueous well-drilling fluid of a pH of about 12 and containing sufficient of a starchy colloid to attain a substantial wall-seal of low water loss and at an operable well-drilling viscosity.

12. An aqueous well-drilling fluid of a pH of about 12 and containing a starchy colloid in an amount sufficient to have a water-loss of less than 5 c.c.

13. An aqueous well-drilling fluid of a pH of about 12 and containing a starchy colloid in an amount sufficient to have a water-loss of less than 3 cc.

14. An aqueous well drilling fluid of a pH of about 12 and containing from 3 to 6% of a starchy colloid as related to the weight of the fluid.

15. In the art of drilling wells by the employment of an aqueous drilling fluid, the process comprising, adding to such a fluid containing clay, a starchy colloid, while the fluid is maintained at a pH of about 12.

16. In the art of drilling wells by the employment of an aqueous drilling fluid, the process comprising, adding to such a fluid a starchy colloid, while the fluid is maintained at a pH of about 12 and adding a concentrated colloidal clay to said fluid.

17. An aqueous clay-laden well-drilling fluid of a pH of about 12 and containing sufficient of a starchy colloid to attain a substantial wall-seal of low water loss and at an operable well-drilling viscosity.

18. An aqueous well-drilling fluid of a pH of about 12 and containing a concentrated colloidal clay and sufficient of a starchy colloid to attain a substantial wall-seal of low water loss and at an operable well-drilling viscosity.

19. An aqueous well-drilling fluid of a pH of about 12 and containing a concentrated colloidal clay and a starchy

colloid in an amount sufficient to have a water-loss of less than 5 cc.

20. In the art of drilling wells by the employment of an aqueous drilling fluid, the process comprising, bringing such a fluid to a pH of about 12 and adding a starchy colloid and a concentrated colloidal clay to said fluid.

21. In the art of drilling wells by the employment of an aqueous drilling fluid, the process comprising, adding to a cement-contaminated drilling fluid, a starchy colloid, while the fluid is maintained at a pH of about 12.

22. In the art of drilling wells by the employment of an aqueous drilling fluid, the process comprising, bringing a cement-contaminated drilling fluid to a pH of about 12 and thereafter adding a starchy colloid to said fluid.

23. The process and fluid substantially as described.

In testimony whereof, we affix our signatures:

May 18, 1943

Dee A. Sikes
Dee A. Sikes

May 21, 1943

Jack H. Beesley
Jack H. Beesley

Oath.

State of Oklahoma } ss.
County of Tulsa }

State of Illinois } ss.
County of White }

Dee E. Sikes and Jack H. Beesley, the above-named petitioners, being duly sworn, depose and say that they are citizens of the United States, and residents, respectively, of the City of Tulsa, County of Tulsa, State of Oklahoma, and the City of Carmi, County of White, State of Illinois; that they verily believe themselves to be the original, first and joint inventors of the improvement in described and claimed in the annexed specification; that they do not know and do not believe that the same was ever known or used before their invention or discovery thereof, or patented or described in any printed publication in any country before their invention or discovery thereof, or more than one year prior to this application, or in public use or on sale in the United States for more than one year prior to this application; that said invention has not been patented in any country foreign to the United States on an application filed by them or their legal representatives or assigns more than twelve months prior to this application; that no application for patent on said improvement has been filed by them or their legal representatives or assigns in any country foreign to the United States; that they have never abandoned the said invention; and that they duly executed the annexed Petition and Specification. And said Jack H. Beesley, further deposes and says that his first full name is "Jack" and that he was baptized under that name.

Dee A. Sikes
Dee A. Sikes

Jack H. Beesley
Jack H. Beesley

Said Dee A. Sikes sworn to and subscribed before me this 18 day of May, 1943.

My commission expires March 5, 1946.

Lillian Settles,
Notary Public.

Said Jack H. Beesley sworn to and subscribed before me this 21 day of May, 1943.

My commission expires Jan. 28, 1947.

J. F. Marlin,
Notary Public.

Patented Mar. 1, 1938 DEFENDANT'S EXHIBIT 1-A. **2,109,858**

UNITED STATES PATENT OFFICE

2,109,858

DRILLING FLUID FOR COMBATING HEAVING SHALE

George E. Cannon, Houston, Tex., assignor to Standard Oil Development Company, a corporation of Delaware

No Drawing. Application June 21, 1935,
Serial No. 27,751

5 Claims. (Cl. 255—1)

In the art of drilling wells for oil and gas by the rotary method, it is important that the properties of the mud laden fluid used in such drilling be controlled within definite limits. The mud must have a certain amount of colloidal material present in order that enough clay particles can be maintained in suspension to impart to the mud a high density. At the same time, the colloidal nature of the mud makes it more effective in plastering the walls of the hole to seal off porous formations and also assist in carrying cuttings out of the hole. However, if the mud be too highly colloidal in nature, it becomes too viscous making it difficult to pump the mud and causing the mud to retain the sand and rock particles which should be settled out of the mud after it reaches the surface of the earth.

Muds which have a deficiency of colloidal material are improved by the addition of a highly colloidal clay such as bentonite, while muds that already have an excess of colloidal material may be put in proper condition for drilling by treating with a chemical agent which reduces or masks the colloidal character of the mud.

In some areas, notably the Gulf Coast of Texas and Louisiana, a formation known as heaving shale must be penetrated in certain wells. It is difficult and often impossible to penetrate this formation by ordinary rotary drilling methods and mud fluids. This shale has a tendency to move into the hole, filling up the hole already drilled and often sticking the drilling tools. Although the cause of this action is not thoroughly understood, it is believed due to the hydration of the shale particles by the water in ordinary drilling muds. A heaving shale may be defined as one which in contact with the ordinary drilling mud swells or disintegrates spontaneously so much as to interfere with the drilling operation. It is highly sensitive to water; also, it is highly colloidal.

In accordance with the present invention, the disintegration of a heaving shale is prevented by addition to an ordinary drilling mud of a high concentration of addition or treating agents which when used alone tend to reduce the viscosity and prevent the gelation of the usual clay mud, and in turn adding to the thus treated drilling mud a plasticizer such as bentonite for the purpose of avoiding the deleterious effect of the excess treating agent on the clay in the mud which would otherwise be encountered. The drilling mud which is subjected to this treatment is the ordinary drilling mud customarily used in drilling through the usual earth formations other than heaving shale. Such a drilling mud has the qualities of plasticity which are satisfactory for use in penetrating the usual earth formations. The addition or treating agent is added to the drilling mud in such a quantity that it would flocculate and precipitate the clay of the drilling mud except that sufficient plasticizer is added to prevent the flocculation and precipitation of the clay. At least fifty to one hundred times as high a percentage of treating agent and plasticizer is added as will ordinarily be used in controlling the viscosity and plasticity of the usual drilling mud. The treating agent operates effectively to minimize the heaving shale from heaving into the drill hole. Sufficient treating agent is added to the drilling mud until a concentration of treating agent is present necessary to prevent disintegration of the heaving shale to be penetrated by the drilling fluid. The amount of treating agent necessary can be readily determined by introducing a sample of the heaving shale into an aqueous solution of the treating agent. If the shale disintegrates the concentration of the treating agent is increased and a second piece of shale is added to the solution. This test is repeated until disintegration of the heaving shale no longer occurs to a serious degree. The drilling mud containing the necessary concentration of treating agent to prevent heaving of the heaving shale, as above determined, is then treated with sufficient plasticizer to develop the viscosity required for an efficient drilling mud.

By way of illustration, the addition or treating agent may be an alkaline material and an organic compound containing three or more hydroxyl groups. Such compositions as sodium hydroxide and tannin or sodium hydroxide and sugar are effective treating agents. Alternatively, sodium hydroxide alone or sodium hydroxide and sugar can be used and some of the advantages of the invention will be retained.

The plasticizers may be bentonite or highly plastic clays. Such materials are highly colloidal and will react with any replaceable water present in the drilling mud, thus reducing the chances of this water reacting with the heaving shale formations.

The drilling fluid to be subjected to the above treatment can be a suspension of ordinary clay in sufficient proportions to form a light drilling fluid and containing sufficient alkaline material to render the mud distinctly alkaline. The water is rendered highly alkaline by means of caustic soda, caustic potash, lime or any other alkaline material. The alkali is preferably added as an alkaline solution of an organic compound containing three or more hydroxyl groups. The organic compound may be tannic acid, humic acid, pyrogallic acid, gallic acid, sugar, starch or the like. The organic compounds need not be pure but may be an impure vegetable extract such as that used in the tanning and other industries. Such an extract is made from vegetation rich in tannin by extracting the vegetable matter with a suitable solvent. For example, the following commercial extracts have been found effective:

- Quebracho
- Archil
- Cutch
- Divi Divi
- Fustic
- Gambier
- Haematine
- Hemlock
- Hypernic
- Logwood
- Myrabolam
- Oak
- Osage
- Orange
- Quercitron
- Redwood
- Spruce
- Sumac

Of these extracts quebracho extract is preferred.

Colloidal material is added which will react with any replaceable water which may be present in the composition, thereby reducing the chances of this water reacting with the shale formations. The colloidal material may be a colloidal clay, such as bentonite or the like. Other colloidal material such as gelatin, agar-agar or the like may be used and some of the advantages of the invention will be retained. Preferably, the mud is prepared by adding the bentonite after the caustic soda and tannic acid have been added. Often the formations penetrated by the drill bit furnish so much colloidal clay that it is unnecessary to add the bentonite to the mud fluid.

In carrying out the invention according to the preferred procedure, a well is being drilled through the ordinary earth formations using the usual drilling mud which comprises an ordinary aqueous clay drilling mud of normal plasticity. The drilling is carried on until the drill arrives at a location near the heaving shale. The drilling mud is thinned down and the treating agent and plasticizer are added to the thinned drilling mud.

The proportions in which the component parts of the drilling fluid are mixed depend upon the density and viscosity required in the drilling fluid, the acidity of the water used in preparing the drilling fluid and the nature of the colloidal material employed. When it is desired to use a high concentration of colloidal material, it is necessary to use more of the alkaline material and the organic material if a low viscosity is to be obtained. By adding the alkaline material and the organic material to the mixing fluid prior to the addition of the colloidal material, it is possible to use higher concentrations of the colloidal material. The effectiveness of the alkaline extract solution may be increased by the addition of a small amount of sodium phosphate. The heaving shale consists of more plastic and less plastic fractions. If the drilling mud is properly treated, the more plastic portions of the heaving shale will come to the top of the well as cuttings. A small portion of the heaving shale goes into the mud. If the drilling mud is not so heavily treated, the more plastic portions of the heaving shale will go into the mud and the mud becomes built up in quantity. In good practice, the plasticizing clay should be more plastic than the heaving shale thereby permitting of over-treating the stabilizing clay sufficiently to prevent attack of the shale by the water of the drilling mud.

By way of specific example, a composition for use with a drilling fluid may comprise:

	Percent
Caustic soda	1
Quebracho extract (crude tannic acid) by weight	1
Bentonite in such quantities as to give the desired density and viscosity, for example	10

The concentrations of the various compounds used can best be determined in the field. The proportions of caustic soda, Quebracho extract and bentonite may be varied over a wide range, but the concentration of caustic soda must exceed ⅓ of 1% by weight of the drilling fluid, if the fluid is to be effective in drilling through heaving shale.

The above composition may be added to an ordinary clay in water drilling fluid. In this composition, the water is the suspending medium, the caustic soda and the Quebracho extract render the composition strongly alkaline and minimize the amount of hydration of the heaving shale. The bentonite is the suspended colloidal material which functions to take up any replaceable water which may be present in the composition.

If it becomes necessary to used drilling fluids having a high density, weighting material such as barytes, iron oxide, silica, powdered oyster shells, calcined clay or the like may be used while maintaining the concentration of caustic soda in excess of ⅓ of 1% by weight of the drilling mud.

An example of a drilling fluid prepared in this manner is as follows:

	Per cent by weight
Bentonite	20
Caustic soda	2
Quebracho extract	2
Water	76

The weight of this mixture is 9.5 pounds per gallon and its viscosity is approximately 20 centipoise.

Another composition comprises:

	Per cent by weight
Bentonite	30
Quebracho extract	2
Caustic soda	7
Water	61

The weight of this mixture is 11 pounds per gallon and its viscosity is 10 centipoise.

If it becomes necessary to use drilling fluids having a density greater than 11.5 or 12 pounds per gallon, weighting material as above described can be added to the drilling fluid while maintaining the concentration of caustic soda in excess of ⅓ of 1% by weight of the drilling mud.

The caustic soda and tannic acid are added to the drilling mud in sufficient amounts so that the concentration of caustic soda exceeds ⅓ of 1% of the drilling fluid. The bentonite is present in the drilling mud in sufficient quantity to maintain the suspension notwithstanding the presence of a relatively large quantity of tannic acid or its equivalent. The drilling mud as above prepared comprises a suspension of clay at least of the order of plasticity of the heaving shale and treated to a suitable viscosity and yield point for drilling mud. Sufficient bentonite is present in the drilling mud to render the mud excessively plastic, except that its plasticity is reduced by the addition of the tannic acid or the like plus alkali in such amounts that the resulting drilling fluid does not attack the heaving shale. This drilling mud in its liquid phase has enough caustic and tannin to slow up hydration of the heaving shale. The bentonite functions as a precipitate resistant in the mud and counteracts the effect of the caustic and tannin which in the amounts added would otherwise precipitate the clay in the mud. The heaving shale is protected by a substantial proportion of mud which is more plastic than the mud through which the drill is being passed.

Various changes may be made within the scope of the appended claims in which it is desired to claim all novelty inherent in the invention as broadly as the prior art permits.

I claim:

1. A drilling fluid for heaving shale comprising an aqueous clay drilling mud containing a mixture of caustic alkali and an organic compound selected from the class consisting of vegetable tannin extract, tannic acid, humic acid, pyrogallic acid, gallic acid, quebracho extract, sugar and starch, the caustic alkali being present in the amount of at least ⅓ of 1% by weight based on the total weight of the drilling fluid, and colloidal material in sufficient quantity to substantially prevent the alkali and organic compound from precipitating the clay and functioning further to take up and hold any replaceable water in the mud and substantially prevent hydration of the heaving shale by the water of the drilling mud.

2. A drilling fluid for heaving shale according to claim 1 in which the colloidal material is a highly plastic clay.

3. A drilling fluid for heaving shale according to claim 1 in which the colloidal material is bentonite.

4. A drilling fluid for heaving shale according to claim 1 in which the caustic alkali is caustic soda.

5. The process of drilling through a heaving shale which comprises flushing through the hole during drilling a drilling fluid containing a mixture of caustic alkali and an organic compound selected from the class consisting of vegetable tannin extract, tannic acid, humic acid, pyrogallic acid, gallic acid, quebracho extract, sugar and starch, the caustic alkali being present in the amount of at least ⅓ of 1% by weight based on the total weight of the drilling fluid, and colloidal material in sufficient quantity to substantially prevent the alkali and organic compound from precipitating the clay and functioning further to take up and hold any replaceable water in the mud and substantially prevent hydration of the heaving shale by the water of the drilling mud.

GEORGE E. CANNON.

Defendant's ~~Exhibit~~ I-B
Role of Clay and Other Materials in Oil-Well
Drilling Fluids by George Stern - Bulletin No.
R.I. 3556. R.I. 3556 - Bureau of Mines - February 1941 -
page 77.

The control of the thickness of the filter cake and its perviousness have a major importance in the control of the drilling operations and frequent routine tests on this property of the silicate mud are recommended. While it is claimed that it is possible to maintain conditions equal to those normally experienced with water muds, the filter test often shows erratic results. Occasionally it is possible to prepare salt-silicate muds which have the surprisingly low filter test of 5 cc. as measured according to the A.P.I. standard method for 30 minutes (3, 4). However the filter cake tends to be brittle and somewhat nonuniform in character; these conditions can be controlled but require careful supervision and add another hazard to the drilling difficulties.

The use of silicate has an objection incident to logging of the hole. A common practice in drilling is to obtain an electrical log of the formations by lowering a set of electrodes into the borehole and noting the electrical characteristics (resistivity and spontaneous potential) of the formation. These electrical determinations are predicated upon the usual condition that the drilling fluid is a relatively poor electrical conductor. The silicate-salt mud, however, contains a high concentration of electrolyte, and therefore is a good electrical conductor; the resulting short-circuiting through the hole slurs the formation character, hence it is extremely difficult to obtain an electrical log of a borehole of diagnostic or usable character when the silicate-salt fluid is used (although recent tests indicate that it is possible); for that reason, many operators hesitate to use it.

Alginate.- Sodium alginate, an extract of kelp, a seaweed abundant off the coast of California, has the characteristic of forming into a fibrous, stringy, gelatinous mass when it reacts with a soluble calcium salt, such as calcium chloride. When wells are drilled, it frequently happens that a porous formation is penetrated, and then some way of sealing off the porosity is desired. To accomplish this the sodium alginate in water solution is pumped down the hole to the position where the sealing is to be accomplished. Then calcium chloride is pumped directly behind, and when the two react, calcium alginate is formed in the fibrous, stringy condition described above. The tough, fibrous matting occurs at the place where it is wanted, and claim is made[9] that it is effective even in porous formations where salt water occurs. Although the cost is appreciable the amount required may be small enough so that it can be used economically if it will accomplish its purpose.

Gum and Starch.- Several gums have been suggested and used as sources of colloidal material. They have been investigated because of the disturbing difficulty from the use of bentonite resulting in flocculation by salt water or other electrolyte. Gum tragacanth and several other organic gums have been tried, but the cost was prohibitive.

Starch has been mentioned as a mud addition agent in the patent literature, notably by Harth (60) and Cannon (21). Harth mentioned it as

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9/ Red Seal Chemical Co., Los Angeles, Calif.

an alternative for bentonite, while Cannon describes its use with high concentration of alkali for drilling through heaving shale.

Starch is inferior to bentonite in those muds in which bentonite is effective, namely, fresh-water mud. Neither starch nor bentonite is effective to prevent filtration in a salt-water mud.

It is only recently that starch has found application in drilling muds as a result of the development that hydrolyzed starch imparts a good filter test to salt-water mud. For this purpose the starch may be hydrolyzed by boiling a 10-percent starch suspension in sodium hydroxide (1 percent by weight; or starch: sodium hydroxide 10:1). A pH of about 11 or 12 has been found desirable.

One important point is that starch tends to ferment unless a preservative is added. An effective preservative is sodium chloride (salt), so that it is possible to accomplish a dual function when drilling through a salt formation. The salt does not flocculate the hydrolyzed colloidal starch suspension, so that the desirable qualities of the mud are not destroyed, and the salt that does enter the mud acts as a preservative to prevent the fermentation of starch. A salt concentration of about 10 percent is adequate. It is surprising that the hydrolyzed starch does not increase the viscosity of the mud (in fact, reduces it slightly) and that the main effect is an improvement in the filter test, even when salt conditions are met. Barnes (7) also proposes the use of starch, with an alcohol, to attain the same objective. Certain clays are added to the mud to give it "body," even though the colloidal portion is replaced by the starch. This starch treatment is less expensive than the silicate drilling fluid and according to Cannon,[10] may be at least equally as effective.

Fibrous Materials.- Sugarcane bagasse, cottonseed hulls, straw, and even wood sawdust have been added to mud to improve its filter test, so that the mud will form a fibrous filter bed to span voids and porous portions of the formation. Recently shredded cellophane scrap has been used successfully, and flake mica (8) has been recommended for the same purpose. Whichever material is used, the purpose is the same - to bridge over the voids and form an impervious, thin, but tough sheath on the wall of the hole.

CONTROL OF MUD PROPERTIES - CHEMICAL TREATMENT

From the variety of materials used in the drilling muds, as described and discussed in the previous paragraphs, it would appear that the character of a mud can be controlled at will by suitable chemical treatment. That is quite true for almost any condition except one. No chemical treatment has yet been found that will prevent flocculation of clay suspensions when contaminated with salt water, although some benefit in resisting the

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[10] Cannon, George E., Humble Oil & Refining Co., Houston, Tex.

Defendant's Exhibit 1-C

STARCH
AND ITS DERIVATIVES

By

J. A. RADLEY
M.Sc., F.I.C.

BEING VOLUME ELEVEN OF A SERIES OF
MONOGRAPHS ON APPLIED CHEMISTRY

Under the Editorship of
E. HOWARD TRIPP, Ph.D.

SECOND EDITION
(REVISED)

NEW YORK
D. VAN NOSTRAND COMPANY, INC.
250 FOURTH AVENUE
1944

that the use of various starches for the preparation of sizes and dressing-agents for textiles is based. Starches processed in the same manner may yield products so dissimilar that they may be used advantageously for different purposes.

The starches most commonly used for the manufacture of adhesive pastes are potato and tapioca, and of these the latter appears more suitable in several respects. Tapioca starch gives adhesives which are more viscous, smoother in working and more easily prepared, whilst the joints made from them are considered by some to show a somewhat higher tensile strength than those made from potato starch. The bitter odour and taste of potato-starch adhesives are also disadvantageous for some types of work.

The processes for preparing adhesives from starch, omitting those which give as end-products substances of a dextrinous nature or chemical derivatives of starch, may for convenience be classified under five main headings as follows :—

1. Treatment with caustic alkalies.
2. Treatment with other alkaline substances.
3. Treatment with acids.
4. Treatment with salts, oxidising agents or swelling agents.
5. Addition of various compounds to starch pastes formed by any of the above methods.

The effect of acids to produce dextrins and adhesives, and the modification of starch by means of oxidising agents, are dealt with elsewhere, and we shall consider them here only in so far as they are bound up with the other processes.

Of the straight starches used for producing adhesive pastes, tapioca, wheat and rye are perhaps the most widely employed and give the strongest and most adhesive pastes. Apart from certain lines of work indicated above, pastes made from starch and water without any special processing are not widely used, and we shall now pass on to consider the preparation of adhesive pastes by the methods outlined above.

Treatment with Caustic Alkalies.—The products obtained by the action of caustic alkalies on starch are known under a variety of names on the Continent ; some of the names are mentioned in the Textile Section, and among other names are those of ' colle universelle,' ' Collodine,' ' colle du japon,' and ' colle froid '.

By the action of caustic alkalies on starch, adhesives can be obtained giving joints with a strength practically equal to or greater than that of the materials joined. Such joints cannot be termed insoluble, but they are only difficultly soluble and resist moisture quite well. These pastes may be made by a cold process or by heating; those made in the cold are possibly not so stable as those made with heat because they tend to show some reversion.

In making cold adhesives the process may be carried out entirely at 15-20° C., and takes about 12 hours to complete. The mucilage may be neutralised either by the addition of an acid or a salt that reacts with the alkali, and sometimes with the starch as well. By using oxidising agents and heating the mass, soft, plastic and transparent adhesives are obtained, which will be dealt with later. The use of strong alkalies allows of the preparation of strong adhesives containing about 33-40 per cent. starch, which can replace dextrin adhesives for a number of purposes, and which are paler, cheaper, and capable of being diluted to a greater extent if necessary. In neutralising the alkali the process is generally allowed to finish slightly on the alkaline side, as this assists the stability of the paste, although it has a drawback in that it may give rise to staining when used with wood veneers; such preparations should not be heated when applying or drying.

Mérimée,[4] as far back as 1827, mentions the advantage obtained by using a weak caustic soda solution for making a starch mucilage for the sizing of paper. The first powdered preparation containing starch and caustic alkali, which when added to water gave an adhesive mucilage, appears to have been that patented by Marsden[5] in 1888. Marsden mixed powdered ammonium sulphate with his mixture of starch and caustic alkali so that on the addition of water the alkali gelatinised the starch and was then neutralised by the ammonium sulphate to give the neutral metallic sulphate, whilst the liberated ammonia gradually passed into the air.

J. Kantorowitz [6] appears to have been the next worker to take out a patent for the treatment of starch with alkalies. He treats the starch with caustic soda and after neutralising with hydrochloric acid precipitates the product either by adding magnesium sulphate or by keeping the mass at 20° C. for several hours. In a further patent he treats the starch with caustic soda in a concentrated solution of sodium sulphate. It should be mentioned that this treatment restrains the swelling of the starch and allows it to be readily separated from the liquor. Alcohol, acetone or mixtures of these with ether have also been used to obtain a similar effect.[8-10]

Simple as is the process of modifying starch with caustic alkalies, it appears to have been modified in approximately a dozen different ways. Leonhardt [11] pre-treats the starch with dilute acid prior to treatment with alkali, a process which is similar in

Defendant's Exhibit 3

USEFUL TABLES

*pH RANGES OF COMMON INDICATORS

Name	pH Range	Color Change
Acid Cresol Red	0.2- 1.8	Red-Yellow
Acid Meta Cresol Purple	1.2- 2.8	Red-Yellow
Thymol Blue	1.2- 2.8	Red-Yellow
Benzo Yellow	2.4- 4.0	Red-Yellow
Bromcresol Green	3.8- 5.4	Yellow-Blue
Bromphenol Blue	3.0- 4.6	Yellow-Blue
Methyl Red	4.4- 6.0	Red-Yellow
Chlorphenol Red	5.2- 6.8	Yellow-Red
Bromcresol Purple	5.2- 6.8	Yellow-Purple
Bromthymol Blue	6.0- 7.6	Yellow-Blue
Phenol Red	6.8- 8.4	Yellow-Red
Cresol Red	7.2- 8.8	Yellow-Red
Meta Cresol Purple	7.6- 9.2	Yellow-Purple
Thymol Blue	8.0- 9.6	Yellow-Blue
Phthalein Red	8.6-10.2	Yellow-Red
Tolyl Red	10.0-11.6	Red-Yellow
Parazo Orange	11.0-12.6	Yellow-Orange
Acyl Blue	12.0-13.6	Red-Blue

*APPROXIMATE pH VALUES

The following tables give approximate pH values for a number of acids and bases. All values are rounded off to the nearest tenth and are based on measurements made at 25° C.

pH VALUES OF ACIDS

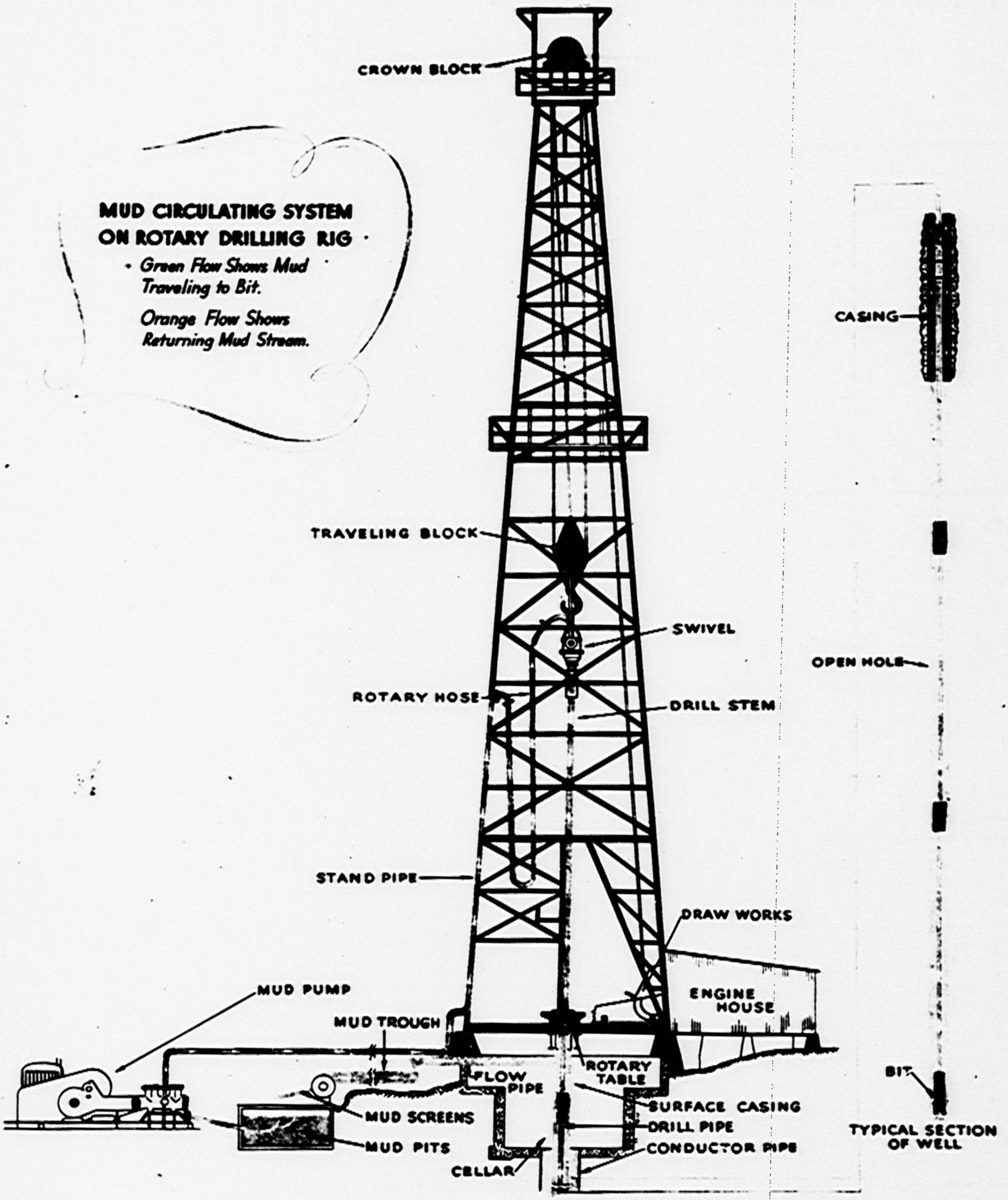
Hydrochloric, N	0.1	Citric, 0.1N	2.2
Hydrochloric, 0.1N	1.1	Formic, 0.1N	2.3
Hydrochloric, 0.01N	2.0	Lactic, 0.1N	2.4
Sulfuric, N	0.3	Acetic, N	2.4
Sulfuric, 0.1N	1.2	Acetic, 0.1N	2.9
Sulfuric, 0.01N	2.1	Acetic, 0.01N	3.4
Orthophosphoric, 0.1N	1.5	Benzoic, 0.1N	3.0
Sulfurous, 0.1N	1.5	Alum, 0.1N	3.2
Tartaric, 0.1N	2.2	Carbonic (saturated)	3.8
Oxalic, 0.1N	1.6	Hydrogen Sulfide, 0.1N	4.1
Malic, 0.1 N	2.2	Arsenious (saturated)	5.0
Boric, 0.1N	5.2	Hydrocyanic, 0.1N	5.1

pH VALUES OF BASES

Sodium Hydroxide, N	14.0	Ammonia, N	11.6
Sodium Hydroxide, 0.1N	13.0	Ammonia, 0.1N	11.1
Sodium Hydroxide, 0.01N	12.0	Ammonia, 0.01N	10.6
Potassium Hydroxide, N	14.0	Potassium Cyanide, 0.1N	11.0
Potassium Hydroxide, 0.1N	13.0	Magnesia (saturated)	10.5
Potassium Hydroxide, 0.01N	12.0	Sodium Sesquicarbonate, 0.1N	10.1
Lime (saturated)	12.4	Ferrous Hydroxide (saturated)	9.5
Sodium Metasilicate, 0.1N	12.6	Calcium Carbonate, (saturated)	9.4
Trisodium Phosphate, 0.1N	12.0	Borax, 0.01N	9.2
Sodium Carbonate, 0.1N	11.6	Sodium Bicarbonate, 0.1N	8.4

* Reproduced from "Modern pH and Chlorine Control;' by permission of W. A. Taylor and Co., Baltimore, Md.

Plaintiff's Exhibit 2 - Drilling Rig



Handbook of Dangerous Materials

By

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BOOK DIVISION

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Shipping Regulations: †
Flammable solid No exemption (206A)* Yellow label 25 lbs. (max. lot)

Sodium Hydrosulfide

Hazardous Properties: This material is a poison. When in contact with acid fumes or heat, it can evolve hydrogen sulfide. When it burns it evolves sulfur dioxide. See **Hydrogen Sulfide** and **Sulfur Dioxide.**

Storage and Handling: Store in a cool, well ventilated place, away from acute fire hazards, powerful oxidizing agents and acid fumes. When this material is involved in a fire, it evolves toxic fumes.

Formula: $NaSH.2H_2O$ *M. Wt.:* 92.1

Description: Colorless needles. Soluble in water, alcohol and ether

Shipping Regulations: † None; Manufacturing Chemists' Assoc. requires warning label.

Sodium Hydrosulfite

Hazardous Properties: A flammable solid and a dangerous fire hazard. It can heat up spontaneously in air in the presence of moisture, and possibly ignite nearby combustibles. When burning it evolves sulfur dioxide, which is extremely toxic. See **Sulfur Dioxide.**

Storage and Handling: Store in a cool, ventilated, dry and detached place away from powerful oxidizing agents and areas of acute fire hazard. Water is not an effective fire-fighting agent; use sand or foam to smother fires of this material. Personnel who are expected to fight such a fire should have protection against the fumes of sulfur dioxide. Containers of this material should be kept closed and plainly labelled.

Formula: $Na_2S_2O_4$

M. Wt.: 174.11 *M. P.:* 55°C

Description: Light lemon-colored solid in powder or flake form or white to grayish-white crystalline powder. Soluble in water, insoluble in alcohol

Shipping Regulations: †
Flammable liquid 153, 204* Yellow label 100 lbs. (max. lot)

Sodium Hydroxide

Hazardous Properties: This material, both solid and in solution, has a markedly corrosive action upon all body tissues of the body. The symptoms of irritation from this material are frequently evident immediately. Its corrosive action on tissue causes burns and frequently deep ulceration, with ultimate scarring. Prolonged contact with dilute solutions has a destructive effect upon tissue. Mists, vapors, and dusts of this compound cause many small burns, and contact with the eyes, either in the solid or solution form, rapidly causes severe damage to the delicate tissue. Ingestion either in the solid or solution form causes very serious damage to the mucous membranes or other tissues with which contact is made. It can cause perforation and scarring. Inhalation of the dust or concentrated mist can cause damage to the upper respiratory tract and to lung tissue, depending upon the severity of the exposure. Thus, effects of inhalation may vary from mild irritation of the mucous membranes to a severe pneumonitis. It can cause an irritant dermatitis.

Treatment and Antidotes: Speed in removing this caustic from contact with the skin of one who has come in contact with it is important to avoid injury. Persons so injured should be referred to a physician. Remove all contaminated clothing at once and if possible give patient a shower under deluge type of shower using plenty of water. If the eyes are involved, they should be irrigated at once with plenty of warm water for 15 minutes. Call a physician.

Storage and Handling: Wherever this material is handled, used, or stored, an abundant supply of water should be on hand for emergency washing. Spilled caustic, if in the dry form, should be shoveled up immediately and the area flushed with water. Then use dilute acetic acid to neutralize the final remaining traces. If solution has been spilled, it should be mopped up and then followed by a liberal covering of bicarbonate of soda to remove the last traces. No spillage of this material should ever be left unattended, since personnel who are unacquainted with the accident may fall into the material and consequently become severely injured.

Those who must work with it or be exposed to its dusts or concentrated mists should use protective equipment. Recommended are chemical safety goggles of the gas-tight variety, rubber gloves, aprons, rubber safety shoes, boots, and cotton coveralls which fit snugly at the neck and wrists. A U. S. Bureau of Mines approved respirator should be worn to avoid excessive inhalation, and personnel who must enter areas of high or unknown concentration or who must be where accidents have occurred should wear a rescue harness and life-line with an attendant posted to avoid mishap.

This material should be stored in a cool, dry place. Containers should be kept closed and plainly labelled. It should be stored carefully to avoid mechanical injury to containers. When such containers are opened or the contents otherwise exposed to the air, this material rapidly picks up moisture and turns into a sticky, corrosive mass. It is usually shipped in iron drums.

Synonyms: Caustic soda; sodium hydrate; lye; white caustic

Formula: NaOH

M. Wt.: 40.01 *M. P.:* 318.4°C

B. P.: 1390°C *Density:* 2.130

Description: White deliquescent pieces; lumps or sticks

Plaintiff's Exhibit 3-A

A Review of Recent Advances In Drilling-Mud Control

PX 3A

By PRESTON E. CHANEY, Sun Oil Company

A GENERAL review of the colloidal chemistry of clays and shales is presented as a theoretical background for the explanation of the various mud problems, and for the chemical treatments used in their correction.

Each of the common mud problems is discussed separately, and an attempt is made to provide a method of diagnosing the cause of trouble from changes in the physical properties of the mud. Following this diagnosis, one or more methods of treatment for correction of the trouble are described, and the theoretical explanation for the action of the corrective treatment is presented whenever possible.

A table showing the combinations of mud properties, or "symptoms" associated with each type of trouble, together with an outline of the corrective treatment, is presented as an aid in rapidly deciding upon the cause of trouble and in selecting the proper treatment.

This paper was presented before the Division of Production at the Twenty-third Annual Meeting of the American Petroleum Institute, Chicago, Ill., November 10, 1942.

IN RECENT years the technique of mud control has made rapid advances. The research engineers of the oil industry, of the universities, and of the commercial mud and chemical companies have sought and found explanations for many of the peculiarities of mud behavior. Consequently they are able to predict more accurately than before the response of mud to various treatments and, in many cases, to avoid trouble as well as to correct it.

Unfortunately, the field mud engineer often does not have the opportunity to study the literature and to perform the experiments necessary to a practical field application of these new discoveries. Consequently there is a gap between the research departments and field practice which delays the advance in field mud-control technique. To the practical mud engineer, the research man often seems too theoretical, and to the research man, the field engineer seems unwilling to accept new ideas. However, it is necessary to efficient operation that these groups cooperate.

In this paper an attempt is made to bridge this gap between laboratory and field practice. The ordinary mud troubles are considered, and an effort made to explain theoretically both the cause of the trouble and the effects of the corrective chemical treatment. The paper has been written primarily from a practical standpoint, and to the research engineer the theoretical phases probably will appear overly simplified. Most controversial points of theory have been omitted in order to avoid confusion, and only those theoretical explanations which, in the author's opinion, best seem to fit the facts are included. All methods of mud treatment suggested in the following pages have been used successfully and economically in the field.

It is realized in presenting this paper that criticism will come from both research and field engineers, for the reason that a compromise between the two points of view has been attempted. However, if the paper serves to draw these two groups nearer to mutual understanding, and to further the application of fundamental colloid chemistry in the analysis and treatment of field mud problems, it will have served its purpose.

Daily Field Tests on Drilling Mud

The following tests are essential to any proper estimation of mud condition. They should be conducted daily, or more often in case of trouble. A suitable form, or a place on the daily drilling report, should be provided for reporting the results of these daily tests:

1. *Weight* (pounds per gallon, pounds per cubic foot, or pounds per square inch per 100 feet of depth).
   (*Note:* Hydrometer or balance should be adjusted to the calibration mark with water at least once per day when weight is critical.)
2. *Viscosity* (Marsh-funnel) (in seconds).
   (*Note:* When commercial weighting materials are used, and in all deep drilling, weight and viscosity should be determined at frequent intervals.)
3. *Sand and total solids* (percent).
   (One sample from pump suction, and one from flow line.)
4. *pH.*
5. *30-min filter test:*
   a. Record milliliters of filtrate at end of 30 min.
   b. Record cake thickness (32nds of an inch).
6. *Salt*—reported as parts per million of chloride.
7. *Remarks:*
   In the daily report, under "remarks," record any mud properties such as high gel rate, gas bubbles, etc., which may be observed from the general appearance of the mud, but which are not indicated directly by the foregoing test results. Also note any tight sections in the hole or other drilling difficulties which might possibly be corrected by suitable adjustments of mud properties.

The American Petroleum Institute has recommended standard methods of conducting the foregoing tests, and detailed procedures may be found in their publication entitled *API Code No. 29: "Recommended Practice on Standard Field Procedure for Testing Drilling Fluids," second edition (1942).*

Inasmuch as such a large proportion of all mud troubles is of chemical origin, it is essential that the field engineer have a working knowledge of the chemistry of colloidal clays. The following discussion of colloidal-clay chemistry is presented only as a review or survey of the literature. For a more complete study of this subject, the reader is referred to the list of references at the end of this paper.

Hydration of Clay Colloids

Colloidal materials may be divided into two general types, according to their action when suspended in water:

The *suspensoids, or hydrophobic colloids,* have little affinity for water, and only form a stable suspension if the individual particle charge is sufficiently high to prevent coagulation. Such colloids do not swell in water. The emulsoid or hydrophilic colloids, on the other hand, have a strong affinity for water. Each emulsoid particle "hydrates," or sheaths itself in a protective film of water molecules, and a noticeable swelling of the clay particles results.

The *bentonitic-clay colloids* belong to this latter class, and most of the common mud troubles are caused by undesirable reactions involving these clay colloids. The bentonitic clays and shales are micaceous in structure; i.e., the individual clay particles are thin flat sheets stacked in mica-like layers. On one of the flat surfaces of these individual leaflets are attached cations, such as Na^+, H^+, Ca^+, etc. The opposite surface, due to internal structure, is slightly negative with respect to the surface bearing these cations. Consequently there is a weak electrostatic attraction between opposite faces of adjacent particles which serves to bind the plates together.

This bonding force is so weak that water molecules may enter and spread the plates apart. This process is responsible for the swelling of the clay, and the "planar water" so attached comprises a large part of the total water retained by the clay colloids.

This planar water is held in place by the weak residual electrostatic forces of the clay particles. These forces increase with increasing ionization of the clay particles; and it is, therefore, to be expected that the degree of swelling and the amount of water retained by the clays should vary according to the particular alkali or alkaline-earth metal present. The relative degrees of ionization of the more common clay salts decrease in the order Li, Na, K, NH_4, Mg, Ca, Sr, Ba, H, according to Jenny and Reitemeier.[1] Consequently the degree of hydration and the relative stability of the clays decrease in the same order. This means that, for a given clay concentration, a clay containing sodium ions will swell more in water and will have greater stability in general than a clay in which the sodium is replaced by calcium or magnesium.

Clays are known by the predominating positive ion as: sodium bentonite, calcium bentonite, etc. The best drilling clays are practically pure sodium bentonites, inasmuch as these clays can retain relatively larger quantities of water and are more stable and more readily dispersed than the alkaline-earth clays, such as calcium bentonite.

Effect of pH Variation on Clay Colloids

The pH of a solution is defined technically as the logarithm of the reciprocal of its hydrogen-ion concentration. In simpler terms, we may consider pure water, which has a pH of 7.0, as neutral. The addition of an alkali, such as sodium hydroxide, increases the pH, whereas the addition of an acid will reduce the pH. As the pH of a solution is reduced, the solution becomes progressively more acid; and, as the pH is increased, it becomes progressively more alkaline.

Variations in the pH, or hydrogen-ion concentration, of a clay suspension produce corresponding changes in the physical properties of the suspension. The pH of a suspension of pure hydrogen bentonite, as obtained by electrodialysis, is in the range 2.0 to 3.0. If sodium hydroxide be added slowly to this suspension, the pH will increase, and the hydrogen ions will be replaced by sodium ions up to a pH between 9.0 to 10.0. At this point the hydrogen ions are replaced completely by sodium, and the clay is now a sodium bentonite rather than a hydrogen bentonite.

Garrison and ten Brink[2] have plotted the course of viscosity and gel-rate variations with increasing pH in bentonite suspensions. They found that in the range of pH 4.5 to about 10.5 the viscosity at low rates of shear decreased with increasing pH, and that a minimum in both viscosity and gel rate occurred in the range of pH 9.5 to 10.5. However, Garrison[3] has shown that the ultimate gel strength of the suspension increases with increasing pH. Thus an increased pH tends to reduce the gel rate, but increases the gel strength; whereas a reduction in pH produces the opposite effect. Hence, to a certain extent, it is possible to adjust the relationship between gel rate and ultimate gel strength by pH control.

The mud pH also has an appreciable effect upon the rate of dispersion of shale colloids into the mud system, as has been demonstrated by Garrison, ten Brink, and Elkin.[4] Under the influence of fluid motion the rate of dispersion of shales into the mud stream increases with increasing pH. Therefore, it is possible to increase the yield of natural mud from the shales drilled by maintaining the mud pH in the range of 9.5 to 10.5, rather than in the more usual range of 8.0 to 9.0. On the other hand, when heavily weighted muds are used and trouble is encountered from the rapid accumulation of colloidal material in the mud, it is advisable to reduce the pH to a value between 7.5 and 8.0 in order to retard the rate of shale dispersion.

Also, this treatment is advisable when bentonitic heaving shales are encountered, as a low pH reduces the tendency of these shales to swell and heave into the hole. However, low pH values tend to reduce the gel strength of muds below satisfactory limits, and this fact should be kept in mind whenever pH reduction is contemplated.

Viscosity Relationships of Clay Suspensions

There are at least three factors entering into the viscosity-concentration relationship for any given clay suspensions; these are: 1, the mutual repulsion due to particle charge; 2, the degree of hydration of the colloid particles; and, 3, the mutual attraction due to unsatisfied or partly satisfied broken-bond valences.

1. Repulsive Forces Between Clay Particles: The bentonitic clays may be considered as salts having a normal positive ion, such as sodium or calcium, but having an extremely large negative ion, consisting of the remainder of the clay particle. These "salts" are ionized to give a positive (sodium, calcium, etc.) ion, and a negative "bentonite" ion. The degree of ionization and, therefore, the effective negative charge on the bentonite particle, depend on the positive ion with which the particle is combined. Thus a sodium bentonite will have a relatively higher negative particle charge than a calcium bentonite because of its higher degree of ionization. This negative particle charge causes a mutual repulsion between the particles, and tends to reduce particle friction and to prevent the formation of aggregates such as are formed when a drilling mud is flocculated by cement. This effect alone would tend to yield lower viscosities in sodium-bentonite suspensions than in calcium-bentonite suspensions of the same concentration, but the expected reduction in viscosity due to greater repulsive forces in the sodium-bentonite suspension is more than balanced by the increase in viscosity due to the higher degree of hydration.

2. Hydration of Clay Particles: The greater degree of ionization and the greater positive-ion hydration of sodium bentonites cause these clays to swell more and to absorb higher percentages of water than the corresponding calcium bentonites. The absorption of water by the clay particles increases their effective diameter, and at the same time inactivates a portion of the water in which the clay is suspended. Both of these effects tend to increase the viscosity of the clay suspension, and are responsible for the fact that higher viscosities are obtained with a given clay concentration using sodium bentonites than with calcium bentonites.

The stability of colloidal suspensions is due to hydration and to the repulsive forces between the individual colloid icles. Any added impurity which tends to reduce the ree of hydration or the particle charge will reduce the bility of the suspension. Thus, when a salt-water flow curs, the high salt concentration in the drilling fluid serves dehydrate the clay colloids and to repress their ionization. is reduces the forces stabilizing the suspension and causes cculation and settling of the clay colloids.

3. Attractive Forces Between Clay Particles: The third ctor influencing the viscosity of clay suspensions is that mutual attraction due to unsatisfied broken-bond valences. s previously explained, the individual clay particles are thin at sheets, which theoretically could have an unlimited idth and length. However, in all natural clays these sheets re broken into sections of very minute width and length. At he surface of this fracture, there are frequently residual valence bonds which originally served to hold the larger sheets together, but which now are left chemically unsatisfied. These residual valences are satisfied in part by the adsorption of water at the broken surface, but there remains a relatively strong attractive force tending to pull another clay particle into a position such that it will form a continuation of the clay sheet and completely satisfy the residual valences of both clay particles. This attractive force between the particles tends to increase the friction between them, and thus increases the viscosity of the clay suspension. Furthermore, when the clay suspension is allowed to remain quiescent for a short time, the particles tend to arrange themselves in a definite pattern and to resist any force tending to destroy this pattern. This latter effect is responsible for gelation, and will be discussed more fully in a subsequent paragraph.

Action of Viscosity-Reducing Chemical on Clay Colloids

The primary effect of viscosity-reducing chemical is believed to be a neutralization of these residual broken-bond valences. By the absorption of certain negative ions at the broken-bond surface, these resdiual valences are satisfied almost completely. Among those negative ions preferentially adsorbed at the broken-bond surfaces are the tennates, gallates, and the complex phosphate ions, such as hexametaphosphate, pyrophosphate, and tetraphosphate. The adsorption of these ions at the broken-bond surface alters the balance of forces acting between the clay particles from a preponderantly attractive force, due to these residual valences, to a preponderantly repulsive force, due to the normally weaker negative particle charge produced by ionization. As the forces acting between the particles are now preponderantly repulsive, the particles tend to avoid contact with one another. Particle friction, and the tendency to form gel structures, thus are reduced, with a consequent reduction in the viscosity of the clay suspension, or drilling mud.

Gelation of Clay Suspensions

The gelling qualities of a clay suspension are dependent upon the relative attractive and repulsive forces between the clay particles. If the attractive forces due to residual valency are strong and the repulsive forces due to ionization are weak, the mud will have a high gel rate and gel strength. On the other hand, if the repulsive forces are strong, while the attractive forces are weak, the mud will have a slow gel rate and a weak ultimate gel strength.

Any change which tends to alter the relationship between these attractive and repulsive forces will have a pronounced effect upon the gel characteristics of the mud. The addition of small quantities of soluble calcium salts or relatively larger quantities of sodium salts reduces the degree of ionization and, therefore, the negative charge on the clay particles, without materially changing the attractive forces. Consequently the gel rate and gel strength of the mud will be increased. On the other hand, the addition of a complex phosphate, for example, will neutralize the residual broken-bond valences without appreciably reducing the ionization of the clay. Hence the attractive forces are reduced in proportion to the repulsive forces, and a reduced gel rate, gel strength, and viscosity result. In some cases it is difficult to control viscosity by chemical treatment without undesirable reduction in gel strength. Loomis, Ford and Fidiam[8] have suggested that under such conditions sodium chloride be added to the mud. The addition of moderate amounts of salt (sodium chloride) reduces the repelling forces between the clay particles, by repressing the ionization, and tends to increase the gel strength. However, this treatment has not been used in the field by the author.

Common Mud Troubles and Chemical Treatment for Their Correction

The author's experience indicates that, in general, each mud trouble produces certain definite changes in the mud properties that are characteristic of that particular trouble. Therefore, it is usually possible to "diagnose" the cause of any given mud trouble from a careful study of changes in the various mud properties produced by it. In this connection it is important to note that changes in the mud properties, rather than their actual values, are used in this diagnosis. The actual values obtained at any one time from the usual mud tests are important to the drilling operation, but often are not sufficient to enable the engineer to diagnose properly the cause of mud troubles. For example, it is possible to produce a very satisfactory mud having a chloride concentration as high as 5000 parts per million. However, if we start with a mud having a chloride concentration of 1000 parts per million and suddenly increase the concentration to 5000 parts per million, the water loss, gel rate, gel strength, and viscosity will increase beyond satisfactory limits, and the treatment described in following paragraphs for high salt concentrations will be necessary in order to recondition the mud.

Cement Contamination

One of the most common mud troubles is cement contamination. Usually no "symptoms" are required to locate this trouble, because it may be expected whenever operations require that cement be drilled, and particularly when the cement has not set thoroughly.

Effect of Cement on Clay Colloids: Calcium hydroxide (slaked lime) is present in cement slurries, largely as a result of the hydrolysis of various alkaline calcium silicates and aluminates. The calcium hydroxide so formed is responsible for the observed changes in the mud properties. The calcium ion replaces the sodium on the clay particles, thus converting them to calcium bentonite, while the hydroxyl ion produces a sharp increase in the mud pH. As discussed previously, the calcium clays are not so highly ionized as the sodium clays. Consequently the degree of hydration and dispersion of the clay colloids is reduced. This accounts for the increase in water loss resulting from cement contamination. A further effect of the calcium ion is a flocculation of the clay colloids; i.e., the colloid particles are caused to combine into aggregates of much larger size. Flocculation is responsible for the high viscosity and gel rate of cement-cut muds. The increase in pH, due to the hydroxyl ion coming from the slaked lime, tends to increase further the gel strength of the mud, and thus adds to the trouble.

Corrective Chemical Treatment for Cement Contamination: In treating a cement-contaminated mud we must accomplish the following results:

1. Remove the calcium ions as an insoluble precipitate.
2. Reduce the pH to approximately the value before contamination.

disperse the clay aggregates as much as possible.
eplace with fresh clay any colloidal material that cannot
restored readily to its original condition.

practical application, the first three of these aims are
mplished simultaneously, whereas the fourth is not usu-
begun until the pH has been reduced to its proper value.
he first treatment consists of a mixture, in about equal
portion, of monosodium orthophosphate and one of the
plex phosphates, or of sodium acid pyrophosphate used
ne. The complex phosphate acts as a dispersing agent to
ak up the clay aggregates, whereas the monosodium
osphate removes the calcium and reduces the pH accord-
to the following chemical reactions:

$$3\,Ca(OH)_2 + 2\,NaH_2PO_4 \rightarrow Ca_3(PO_4)_2\downarrow + 2NaOH + H_2O$$

$$NaOH + NaH_2PO_4 \rightarrow Na_2HPO_4 + H_2O$$

The first of these reactions is complete before the second
gins. It will be observed that sodium hydroxide (caustic
da) is a product of the first reaction and, as this com-
ound is a strong alkali, the pH will not be reduced mate-
ally until this reaction has been completed and the second
egins. Therefore, by watching for a sharp change in the
H we can tell when all calcium has been precipitated. At
his stage in the treatment, the mud usually has a satisfac-
ory Marsh-funnel viscosity—although the viscosity is some-
imes even lower than desired, but the rapid gel rate makes
he mud appear to have a much higher viscosity, and the
igh water loss remains unchanged. Addition of fresh ben-
tonite may be begun at this stage if the water loss is ex-
ceptionally high, but usually it is better to reduce the pH to its original value by continued use of monosodium phosphate (with only enough complex phosphate to maintain desired viscosity) before clay is added. When the pH has been restored to its original value, the use of monosodium phosphate is discontinued; and, as the final step in the treatment, the ordinary viscosity-controlling agents are used to maintain satisfactory viscosity while the bentonitic clay is being added to reduce the water loss and gel rate of the mud to the desired values.

Pretreatment for Cement Contamination: When it is known in advance that cement contamination will take place, it is advisable to pretreat the mud with as much monosodium phosphate or sodium acid pyrophosphate as can be added without reducing the pH too low or otherwise damaging the mud. This pretreatment will reduce mud flocculation greatly during cement drilling by precipitating most of the undesirable constitutents of the cement before serious damage to the mud has occurred.

Lime, Gypsum, Anhydrite, Etc.

As mentioned in the section on cement contamination, any soluble calcium salt will cause the flocculation of colloidal clays. In normal drilling, sections of lime or limey shale, anhydrite, gypsum, etc., are encountered. These calcium salts are sufficiently soluble to cause trouble from clay flocculation.

Effect of Calcium Salts on Clay Colloids: The characteristics of a mud containing soluble calcium salts depend somewhat on the past history of the mud. One of the peculiarities of clay colloids is the effect of calcium salts on the viscosity. If a soluble calcium salt—for example, calcium chloride—is added to a dry sodium bentonite and the clay then is dispersed in water, the viscosity will be very low for a given clay concentration. On the other hand, if the clay first is dispersed in water and allowed to hydrate, the addition of a calcium salt then will produce a sharp increase in the mud viscosity.

In the first case the clay is converted to a calcium clay before it has had time to hydrate, and the calcium clay does not hydrate so completely as would the sodium clay. Therefore, the clay particles have a smaller effective diameter, and higher clay concentrations would be required to cause the same degree of particle interference in the suspension. On the other hand, if the clay first is hydrated, the individual particles have a large diameter due to the swelling produced by hydration. The addition of calcium then flocculates or coagulates these larger particles, causing them to be attracted by one another. This increases the particle friction, with a consequent increase in viscosity.

Effect of Calcium Salts on Field Drilling Muds: In drilling a large shale section containing only moderate amounts of calcium and magnesium salts, the mud will be converted gradually to a calcium-bentonite mud as the original clay is deposited as a filter cake on the walls of the bore hole and is replaced by these calcium or magnesium clays. This will result in a decreased mud viscosity, a fast gel rate, and usually a slight increase in the water loss.

However, when large sections of anhydrite or gypsum suddenly are encountered—as, for example, in drilling the cap material on many shallow salt domes—a high concentration of calcium is built up rapidly in the mud. This causes flocculation on the sodium clay present in the mud, and results in an increase of gel rate, viscosity, and water loss. It will be noted that, with the exception of the pH, these are the effects produced by cement contamination; and, as the calcium ion is responsible in both cases, we would expect this similarity in effect.

The first set of "symptoms" of calcium contamination ordinarily is encountered only in shallow drilling, with natural muds containing little or no phosphate. In this case, a limey shale section will be found to produce very little mud. The mud produced will have a fast gel rate and a weak gel strength which prevent the proper settling of sand; the viscosity will be abnormally low; and the water loss usually is moderately high. Furthermore, the presence of excess free calcium in the mud will convert to a calcium bentonite any fresh dry clay added to the mud before the clay has had time to hydrate—which would make it necessary to add excessive quantities of clay to obtain the desired increase in viscosity and reduction in water loss and gel rate.

The second set of "symptoms" will be found on any mud when large sections of soluble calcium salts are drilled, and to some degree in drilling limey shale sections with muds containing high concentrations of good clay (low water-loss muds).

Corrective Chemical Treatment for Contamination by Soluble Calcium Salts: The primary aim of treatment is to precipitate the calcium as an insoluble compound; this may be accomplished by use of disodium phosphate or soda ash, according to the following reactions:

$$(1)\quad CaSO_4 + Na_2HPO_4 \rightarrow \underset{\text{Insoluble}}{CaHPO_4}\downarrow + Na_2SO_4$$

$$(2)\quad CaSO_4 + Na_2CO_3 \rightarrow \underset{\text{Insoluble}}{CaCO_3}\downarrow + Na_2SO_4$$

The choice between these two treating agents is based on the pH of the mud prior to treatment. Disodium phosphate produces little or no change in the mud pH, whereas soda ash increases it sharply. Therefore, disodium phosphate should be used if the mud pH is satisfactory, and soda ash is the correct choice if an increase in pH is desired; monosodium phosphate may be used occasionally if the initial pH of the mud is high.

In this connection, it is advisable to review the foregoing discussion of pH. Usually, in drilling limey shale sections with natural mud, little or no mud is formed from the shale. In order to make more mud from the formation, it is desirable to have the pH in the range 9.5 to 10.0. Therefore, in this case soda ash would be the proper selection.

One of the usual viscosity-reducing chemicals must be used along with the soda ash or disodium phosphate in order to maintain a satisfactory viscosity and to disperse the clay colloids, as these chemicals are not effective in viscosity control.

Particularly in the case of natural muds composed largely of calcium shales it will be found that little change in the mud properties is noticeable until the removal of calcium is practically complete. The viscosity will remain low, and the mud will show a fast gel rate and a weak gel strength, up to the time that sufficient soda ash or disodium phosphate has been added to remove the calcium completely. Sometimes this is discouraging, because treatment may be continued for three or four complete circulations of the mud without any noticeable improvement; however, continued use of the calcium-precipitating agent will give the desired results.

An effort now is being made to develop a satisfactory field test for estimating the calcium concentration in drilling muds. The results of this work, if successful, will be published in the near future.

Gas Cutting

Gas cutting is largely a mechanical, rather than a chemical, problem in mud control. The hydrostatic head of the mud column must be slightly greater than the formation pressure at every point in the hole in order to prevent the flow of formation fluid into the mud system. Gas in the mud indicates that the hydrostatic head of the mud is too low to meet this requirement, and the obvious solution is to increase the mud weight by the addition of commercial weighting materials, such as barytes (barium sulfate).

The addition of weighting material should be begun at the

Outline of Ordinary Mud Troubles, Their Symptoms, and Common Methods Used for Their Correction

Cement Contamination

Symptoms:

1. Increased gel rate and gel strength.
2. Increased pH.
3. Increased viscosity.
4. Increased water loss.

Chemical Treament:

1. Mixture of monosodium phosphate and complex phosphates, or sodium acid pyrophosphate alone, until pH returns to value, before contamination.
2. Add colloidal clay slowly, with continued use of complex phosphate to control viscosity, until water loss and gel rate return to normal.

Soluble Calcium Salts

(Lime, gypsum, anhydrite, etc.)

A. In drilling limey shales with natural drilling mud:

Symptoms:

1. Mud viscosity usually low.
2. Rapid gel rate, weak gel strength.
3. Practically no new mud formed from shales drilled.

Chemical Treatment:

1. Add soda ash (alkaline), or disodium phosphate (neutral), depending on initial pH, until viscosity begins to rise. There will be little if any improvement in mud properties until treatment is practically complete. Then viscosity and gel characteristics improve rapidly.
2. If gel rate is still too high after viscosity increases to desired value, use mixture of soda ash or disodium phosphate with sufficient complex phosphate to control viscosity until gel rate is satisfactory.
3. Colloidal-clay additions may be required to give satisfactory wall-building characteristics.

B. In drilling beds of gypsum, anhydrite, etc. (large quantities of soluble calcium salts suddenly encountered):

Symptoms:

1. Increased gel rate and gel strength.
2. Increased viscosity.
3. Increased water loss and cake thickness.

Chemical Treatment:

1. Use mixture of disodium phosphate and complex phosphate to remove calcium and control viscosity.
2. Add fresh bentonite as required to hold required water loss.
3. Quebracho useful in reducing gel rate.

High-Pressure Gas

Symptoms:

1. First indicated by minute gas bubbles which do not readily break out of mud. Best seen by raking surface of mud sample and observing for bubbles at freshly exposed surface.
2. More severe stages:
   a. Strong gas odor at flow line.
   b. Gas pockets cause mud to flow by heads.
   c. Distillate forms emulsion with mud, which reduces effectiveness of chemical treatment.
   d. Volume of mud in pit increased just before blowout, indicating that mud is leaving hole faster than pumps can handle it.

Chemical Treatment:

1. At first definite indication of gas put guns on pit and start mixing weighting material to overcome gas pressure. Increase chemical treatment to reduce viscosity and gel rate of mud. Mark level of mud in pit, and observe frequently for any increase or decrease in mud level.
2. In extreme cases, close blowout preventers and put mud discharge on choke. Choking mud discharge should be done only when absolutely necessary, as this slows circulation of mud and thereby concentrates the gas in a smaller volume.
3. Immediate action is the best solution to gas cutting. Any unnecessary delay in increasing mud weight causes recirculation of gas—cut mud and increases the danger of blowout.

Rock-Salt or Salt-Water Flow

Symptoms:

1. Rapid increase in salt content of mud.
2. First effect is increased gel rate and viscosity. After several hours, or perhaps a day, viscosity drops below normal.
3. Water loss increases rapidly.
4. In case of salt-water flow, mud continues to flow after pumps have been shut down.

Chemical Treatment:

1. In case of salt-water flow, increase mud weight as rapidly as possible until shutoff is obtained, but

(Continued on next page)

Plaintiff's Exhibit 4

LIME - CAUSTIC SODA - IMPERMEX

APPARATUS AND MATERIALS

Regular Baroid Sales Division laboratory testing equipment was used.

Distilled water was used in preparing the mud suspensions. The clay was Baroid's B-2 from a deposit in Fayette County, Texas and is used in oil well drilling. The starch is a pregelatinized variety sold commercially as "Impermex" by the Baroid Sales Division, and is manufactured by the Corn Products Refining Company, Pekin, Illinois. The lime and caustic soda were of chemically pure grade.

PROCEDURE OF TESTING

A 10 percent hydrated clay suspension was prepared by the addition of dry clay to distilled water and stirring 15 minutes at high speed with a Hamilton Beach mixer #30. 350 cc portions of the clay suspension were placed in eight pint Mason jars. Lime was added to one series of four samples, designated as "A" in the attached table, and caustic soda was added to the other series "B" to raise the pH to above 12. The samples were stirred 10 minutes, and then to each series of four samples, starch was added to provide concentrations of 0, 4, 8 and 12 lb/bbl.

After stirring five more minutes, the jars and contents were sealed, placed in a mechanical roller oven and aged by rolling 11 hours at 150°F.

After aging, the mud suspensions were cooled to room temperature (75°F), the pH values adjusted to 12.1, and the drilling mud properties were determined after stirring for 10 minutes.

The pH values after aging were not less than 11.5 in all samples nor greater than 12.1. Adjustments of pH were made with the base used originally for each series.

TABLE I

PROPERTIES OF LIME AND CAUSTIC SODA TREATED CLAY SUSPENSIONS CONTAINING STARCH AT pH 12.1

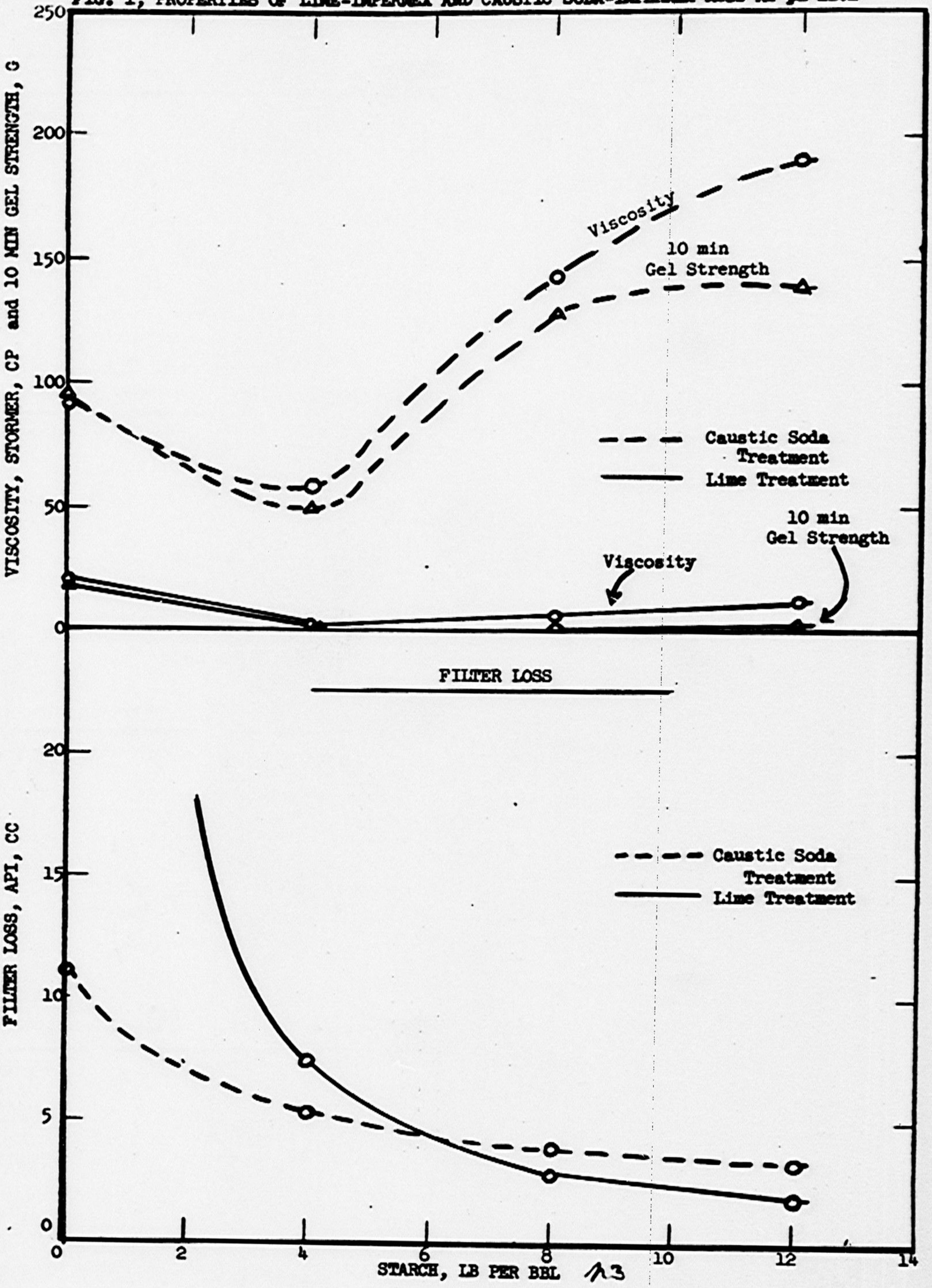
MUD: 10% by wt hydrated Fayette County clay. Properties after aging 11 hr at 150°F at pH 12.1 through additions of lime or caustic soda

Starch, lb/bbl	0		4		8		12	
	A	B	A	B	A	B	A	B
Viscosity, cp	19	92	3.2	59	6.7	143	12.6	190
Gel strength, initial, g	17	34	0	7	0	90	0	105
10 min, g	17	95	0	50	0	127	0	139
Filter loss, API, cc	152	11.1	7.5	5.3	2.8	3.9	1.9	3.3

A - Lime Treatment

B - Caustic Soda Treatment

FIG. 1, PROPERTIES OF LIME-IMPERMEX AND CAUSTIC SODA-IMPERMEX MUDS AT pH 12.1



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United States Court of Appeals
For the
District of Columbia Circuit
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APPELLANT'S BRIEF.

UNITED STATES COURT OF APPEALS

FOR THE DISTRICT OF COLUMBIA.

No. 11,735.

NATIONAL LEAD COMPANY, a Corporation,
New York, New York,
Appellant,

v.

ROBERT C. WATSON, Commissioner of Patents,
Washington, D. C.,
Appellee.

Appeal from the United States District Court for the
District of Columbia.

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STATEMENT OF QUESTIONS PRESENTED.

The application in suit, for a process, is based on a discovery, that if a well-drilling fluid containing gelatinized starch is maintained at a high alkalinity by the addition of lime, then the drilling fluid will not only be rendered and maintained immune against deterioration of the gelatinized starch, and so as to provide a wall seal of low water-loss, but an entirely new drilling fluid is produced.

The Stern Bulletin discloses the gelatinization of raw starch by caustic soda and the addition of the same to a drilling fluid. It does not disclose a well-drilling fluid maintained at a high pH by the addition of lime.

The Cannon Patent discloses the use of quebracho (a tannin) with caustic soda. It simply mentions "starch", not "gelatinized starch", as a substitute for quebracho. It mentions "lime" as a substitute for caustic soda. While caustic soda will gelatinize starch, lime will not. Accordingly, the substitution of starch for quebracho, with a second substitution of lime for caustic soda, will not result in a drilling fluid containing gelatinized starch.

UNITED STATES COURT OF APPEALS

FOR THE DISTRICT OF COLUMBIA.

No. 11,735.

NATIONAL LEAD COMPANY, a Corporation,
New York, New York,
Appellant,

v.

ROBERT C. WATSON, Commissioner of Patents,
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APPELLANT'S BRIEF.

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JURISDICTIONAL STATEMENT.

This is a civil action under R. S. 4915, 35 U. S. C. 63, by Plaintiff-Appellant, National Lead Company, assignee of the Sikes and Beasley application, serial No. 653,716 filed March 11, 1946, against Defendant-Appellee, Robert C. Watson, Commissioner of Patents, for a judgment authorizing the Commissioner to issue a patent on that application to Plaintiff. There are no adverse parties other than the Commissioner, because this action is from a decision of the Board of Appeals affirming the Primary Examiner in his rejection of all of the claims remaining in the application, none of them having been allowed. The jurisdiction is set out in the Complaint, App. 1.*

After a trial on testimony of Harold Farnham and Delmar H. Larsen, a deposition of one of the applicants, Beasley, an affidavit of Professor Dodge, and an affidavit of Offeman in the application file, the District Court rendered an Opinion, App. 6, in favor of the Commissioner refusing all of the claims in suit, and approved the Findings of Fact, Conclusions of Law and Judgment submitted by the Commissioner, App. 10-12, dismissing the complaint. This appeal is under 28 U. S. C. 1291.

STATEMENT OF CASE.

Preliminary Observations.

This case involves an application of Sikes and Beasley Px 1, App. 76, assigned to Plaintiff, for a process entitled,

"Treatment of Well-Drilling Fluids."

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* App. has reference to the Joint Appendix; the transcript will be referred to as Tr.; and the deposition as Dep. 1 noted in the margins of the Appendix.

In the Appendix the exhibits have been, for convenience, placed out of order so that the actions by the Patent Office, viz., Dx 1-D, etc., fall in logical order following the application, its amendments and the appeal.

All emphasis is ours.

A PREVIOUS CASE BEFORE THIS COURT, Appeal No. 10,873, also involved an application of the same inventors and likewise assigned to plaintiff, for a process in the treatment of well-drilling fluids, and this Court, on May 27, 1952, affirmed the District Court, dismissing the bill, 198 F. 2d 296.

There is a clear distinction between the cases. In the case decided on appeal, the claims were so broad that this Court held their foundation was in a Cannon patent and a Stern publication, App. 147, 151. **The claims here are specific** and are not within the disclosures of that patent and that publication.*

The case here involves an application which is a **distinct improvement**, over what was found by this Court to be unpatentable, to such an extent that it has **replaced** the other on a four to one basis, App. 32, Tr. 52. The Cannon Patent and the Stern publication are again relied on by the Patent Office.

The decision of this Court in the appealed case was really based upon the proposition that anyone skilled in the art, carrying out the process of Cannon and Stern, would **inherently** carry out the process of the claims on that appeal, and that the process claims involved only "increase in knowledge" of the properties of the drilling fluids of Cannon and Stern. Opinion p. 5, 198 F. 2d p. 298. In view of the above generalization it will be profitable to first state what it was that was involved in the case on appeal.

This Court, in referring to the process of drilling wells by the rotary system, after describing such a process generally and its environment and later the employment of clays to seal the bore hole, said, page 3, 198 F. 2d p. 297:

---

* Starch and Its Derivatives by Radley, Px 1-C, App. 153, cited by the Commissioner, was not relied on in the Commissioner's brief before the District Court, and was not mentioned in the District Court's opinion or in the Findings of Fact.

> "Viscosity of the fluid must be maintained at a consistency which will enable it to convey the cuttings and also seal the bore hole. This is accomplished by treating the fluid with gelatinized or hydrolyzed starch. Mud so treated, however, ferments unless it contains a substantial quantity of salt. The problem has been to obtain a drilling fluid having the qualities needed to accomplish the desired purposes above indicated in an efficient manner for general use, not merely in formations containing salt, and without fermentation."

This Court then said—

> "The basis of appellant's claim is that its assignors discovered that these results could be accomplished, without fermentation, by bringing the drilling fluid to a high degree of alkalinity."

Note that **no particular agent** is referred to to attain that alkalinity. However the Board of Appeals said in its decision in this case, App. 128:

> "In the above referred to prior application, Appellants made claim to the **broad idea** of establishing and maintaining a pH of 12 of the drilling fluid, no particular alkali being claimed."

Now both Cannon and Stern describe the use of **caustic soda** in a drilling fluid and, of course, caustic soda is an alkali. Cannon, App. 148, page 2 right, gives a number of examples of quebracho (a tannin) and caustic soda in varying proportions in connection with large proportions of Bentonite, 10-30%. However, the Cannon patent **simply mentions** "starch," p. 2 left, line 4, although **not "gelatinized"** starch. Our contention in the appeal, as here, was that ordinary starch would not form a gel and was of no value in a well unless gelled; Farnham, App. 24, Tr. 39. However, the Patent Office said on that appeal, that if

starch were **substituted** for **quebracho,** then two things would happen—namely: (1) The starch would become gelatinized; (2) the pH of the drilling fluid would be at least 12. This Court so found as follows, Opinion, page 4, 198 F. 2d p. 298:

> "The Cannon patent relates to a drilling fluid (for shale) which includes a starch and caustic soda. A 1% solution of the latter will hydrolyze or gelatinize the starch. On adequate evidence the court found that the pH value of a 1% solution of caustic soda is just under 13.0."
>
> "It is clear a well drilling fluid which contained starch and **caustic soda** was **known,** and that when the solution contained 1% of caustic soda the starch **would gelatinize** or hydrolyze; and although it was not so stated by the Cannon patent, it is a fact that the pH value of a 1% solution of caustic soda is just under 13.0."

As to Stern, this Court said:

> "Insofar as the publication of Stern is concerned it was found, also with adequate evidentiary support, that he had explained the use of hyrolyzed starch in a well drilling fluid and said that a pH of about 11.0 or 12.0 had been found desirable."

As a conclusion this Court affirmed the Patent Office and the District Court on that appeal, and found that since Cannon and Stern disclosed the treatment of ordinary starch with **caustic soda** in such proportions as to not only **gel** the starch but to attain a **pH of 12,** then **inherently** that disclosed a process of preventing fermentation of the drilling fluid because that simply involved, as this Court said Decision p. 5, 198 F. 2d 298:

> "Increase in knowledge of its properties did not call for the grant of a patent, Roberts v. Ryer, 91 U. S. 150."

The claims in that suit were, therefore, held invalid, because as was said by the Board of Appeals in this case and just noted, we only made claim to a **broad idea** of establishing and maintaining a pH with **no particular alkali** being claimed. The application on the previous appeal was therefore **too broad** as including caustic soda, which this Court found was disclosed in the Cannon patent and in the Stern publication.

This Case Involves a Distinctly Novel Process Producing a Distinctly Novel Drilling Fluid.

This case involves an entirely **different application**, including an entirely **different process** than was involved in the case decided by this Court. We want to observe that although the application here is stated Px 1, App. 77, to be "a continuation" of the application involved in the preceding case, it is only so "as to common subject matter"; for actually the disclosure in this case stands on its own foundation and can so stand. This case involves an entirely different process, resulting in an entirely different and **distinctly novel drilling fluid**, than that involved in the preceding case; indeed, the process and result are so different that as noted above it has **practically replaced** what preceded it. **None of that has been disputed by the Patent Office.**

We will also show, that when the Cannon and Stern references are applied to the disclosure and claims in this application, in an attempt to answer them, the process will then be impossible and the result will be a useless one, so that the attempt must fail.

Briefly stated the process here is one in which a mud (clay) laden drilling fluid containing **gelatinized starch**, and which is subject to deterioration during the course of drilling, is **maintained** during the course of drilling at a **pH** of about **12** by the addition thereto of **lime** (calcium oxide or calcium hydroxide) in order to inhibit such deterioration, and the drilling fluid is maintained during the course of drilling, at **a low water loss (viz., 5 cc) by** the addition of gelatinized starch.

The **Stern** publication, App. 151 obviously does not disclose such a process, because there **caustic soda** is used to gelatinize the starch, even if the pH of the drilling fluid is brought to and maintained at a pH of 12.

Likewise, the **Cannon** patent, App. 147, obviously does not disclose such a process, because there again as found by this Court, **caustic soda** is again used to gelatinize the starch, even if the pH of the drilling fluid is brought to and maintained at 12.

In this case the Patent Office, having in the appealed case, resorted to the **substitution** in the process of the Cannon patent of starch for Quebracho for use with caustic soda, proceeded here to make a **second substitution,** namely, of lime for caustic soda. The sole basis for the second substitution is that Cannon, App. 147 mentions "lime" as something whereby "the water is rendered highly alkaline," App. 147, p. 1, right lines 52-54. The question then is what will happen if that second substitution is made?

While caustic soda will gelatinize starch, **lime** (calcium oxide or its hydroxide) **will not gelatinize starch,** even at a pH of 12.6. That was shown by the testimony of Farnham App. 46 Tr. 73-74; not even at 180°F. App. 53 Tr. 84; nor at any temperature, but the presence of calcium hydroxide will **prevent** gelatinization of the starch, App. 55 Tr. 86. Farnham was confirmed in the above respect by tests made by Offeman, whose affidavit, App. 94 before the Patent Office was admitted as a part of Px 1. Larsen also confirmed Farnham and the Offeman tests, which Larsen checked and which were in fact under his supervision App. 57 Tr. 90. Larsen also testified that later Offeman again made retests under Larsen's supervision at a temperature as high as (100° C., i. e. 212° F.) and that there was no gelatinization App. 59-60 Tr. 93-95.

None of the above was disputed by the Commissioner's Counsel at the trial, although he cross examined Farnham App. 52-54 Tr. 83-86 and Larsen App. 60-61 Tr. 95-96, on that phase, and it will be noted that the citations in the preceding paragraph included parts of the cross examination.

It will be apparent from the above that the **Cannon patent can be no answer** to the application in this suit, nor to its claims which will be later discussed. That is for the reason that even if the substitution of starch for quebracho will result in gelatization of starch, an attempted **second substitution** of lime for caustic soda will result that the **starch will not become gelatinized**, so that all that will happen is that a drilling fluid is brought at a pH of 12, but with the starch left ungelatinized and therefore of **no value** in a well and moreover the lime will flocculate the clay App. 23-24 Tr. 39-40. In other words such a double substitution will result in something useless and not useful.

In the previous appealed case this Court found that by the mere substitution of starch for quebracho in the Cannon patent and with sufficient **caustic soda, inherently** the starch would become gelatinized and inherently the pH would be raised to 12. However, by the **second substitution** of lime for caustic soda, **inherently the starch will not become gelatinized.** That shows how different the cases are and how the reasoning of this Court in the appealed case cannot be applied to this case.

An attempt was made by the Board of Appeals App. 129 to build up a case by the fact, that **perhaps** in a well whose bottom temperature was 180° F. or above, the starch would become gelatinized, even if the pH was attained by lime, and a like attempt was made at the trial. However, as noted above Farnham answered that as follows:

1. Even at such a temperature or at any temperature there will be no gelatinization of the starch App. 53, 54, Tr. 84, 86.

2. Only one out of 10 or 15 wells have a depth where the temperature is as high as 180° F. App. 48 Tr. 76, so that any gelatinization will be accidental.

3. The statement in the application on the previous appeal DX 2, App. 132, as to the gelatinization at a temperature of 180° F., has reference to the use of soda-lime, Dx 2, App. 137, which Farnham says App. 56 Tr. 88, is sodium and calcium hydroxide in equal proportions, of the use of which we have **no prior art**, so that even as to that the applicants here are prima facie the inventors.

The net result therefore is that by the use of lime in accordance with the Cannon patent, the **sole effect** will be an increase of the pH to 12.6; it is that which the Patent Office erroneously seems to consider as the sole object to be attained by the applicants in this application. However, that is fallacious for the following reasons: As shown by Farnham App. 24, 26, Tr. 40, 43, and confirmed by the Chaney Article Px 3A, App. 160 calcium hydroxide was considered to be in the nature of a poison in the drilling art and to be avoided and neutralized, because lime will flocculate the clay necessarily used in a drilling fluid. Again therefore, the mere raising of the pH by lime was worse than useless.

It is only when lime is used in connection with gelatinized starch, that the objections to the use of lime are not only overcome, but then lime itself is made to do useful work in producing a radically new drilling fluid. That is what is involved in this case.

The Application in Suit.

The application in suit was filed February 28, 1946, as a continuation of application Serial No. 489,890 filed June 7, 1943, as to common subject matter, P. X. 1, App. 77. It is not, however, necessary to rely upon the date of that earlier application, because the Stern and Cannon references antedate both. We can therefore restrict ourselves to the application in suit.

The claims in suit employ the expression "amylaceous emulsoid colloid". This is simply a scientific expression for gelatinized starch which is an emulsoid colloid, and, as stated on App. 77:

> "Where starch is used with water it provides what may be called 'aqueous amylaceous-colloid-laden drilling fluid'."

The general statement of the invention as **originally** filed was P. X. 1, App. 79:

> "Generally stated, and in accordance with an illustrative embodiment of this invention, an aqueous well-drilling fluid composed of clay and an amylaceous-colloid is prepared with the aid of an alkaline-earth metal oxide or hydroxide to attain a high pH, viz., from 11.5 to 12.5 and such pH is thereafter maintained."

That statement was, however, reworded by amendment A^1, App. 85, to read as follows:

> "Generally stated, and in accordance with an illustrative embodiment of this invention, an aqueous mud-laden well-drilling fluid containing an **amylaceous-emulsoid-colloid** is maintained during the course of drilling at a pH of about 12, viz., between 11.5 and 12.5, **by addition** thereto of an **alkaline earth metal** oxide or hydroxide. In order to maintain the drilling fluid during the course of drilling at a low water loss, viz., about 5 cc (API) there is added thereto sufficient

> of the amylaceous-emulsoid-colloid **to effect** that purpose. . . . A colloidal clay such as bentonite may be added to the drilling fluid in order **to** maintain its solid contents during the course of drilling."

That was done to bring it in harmony with **the** claims which were also rewritten App. 86 and which were supported by the supplemental oath PX App. 88. Claim 12 is a rather complete claim, and reads as follows:

> **12.** "In the art of drilling wells through formations by the employment of an aqueous mud-laden well-drilling fluid containing an **amylaceous emulsoid colloid** which is subject to deterioration during the course of drilling, the process, comprising, **maintaining** such a drilling fluid, during the course of drilling, at a pH of about 12 by addition thereto of an **alkaline-earth metal oxide** in order to inhibit such deterioration, and maintaining the drilling fluid during the course of drilling, at a **water loss of about 5 cc** by addition thereto of the amylaceous-emulsoid-colloid."

The "alkaline-earth metal oxide" is **lime,** which may either be in the form of calcium oxide or calcium hydroxide; as stated P. X. 1, App. 79:

> "An alkaline-earth metal oxide which is preferably employed for this purpose is lime, that is calcium oxide, although hydrated lime, that is calcium hydroxide, may be employed."

That is given in the practical example, App. 79, where a clay-laden drilling fluid is brought to a pH of about 12 (11.7-12.5) by the addition of 2 lbs. of lime per barrel of the fluid and with the addition of **12 lbs. per barrel** of gelatinized starch, so as to secure a water loss of 4 cc.

The theory underlying this case is stated as follows, Px 1, App. 80:

> "While the theory of operation is not essential to the employment of this invention it is believed that the

theory of action is about as follows. The high pH will cause **shrinking** of the clay lattice in the solid phase; there may also be a **conversion** of sodium to **calcium clay** or of a negative charge to a positive charge. The net result seems to be that the clay if hydrated will be dehydrated so that the gel-strength will be reduced to practically zero. The clay is, however, completely dispersed into fine particles (practically) on addition of the starch. **The starch will combine with the small clay particles** to form a very efficient water-seal or shut-off with a resultant low water-loss and a very thin cake thickness. The **fluidity** will be **very high** and while this may require increased velocities in order to carry the cuttings out of the well, the pump pressure will, of course, be reduced and withal there will be a **low water-loss.**''

This Process and Its Result Are Distinct and Outstanding.

The process covered by the application in suit and the resulting product are distinct and outstanding **when lime is used in connection with gelatinized starch.**

Farnham testified, App. 33, etc., Tr. 54, etc.:

> ''**Q.** Compare these two systems, namely, the caustic soda-starch system and the lime-starch system, in each case having gelatinized starch. Is there any difference in action between those two on the clay that is used in the drilling fluid? **A.** Yes, there is an **entirely different action** of those two alkaline materials on the clay.
>
> **Q.** In what way, if you can briefly explain? **A.** The clay minerals have attached to them what is known as exchangeable bases, that is, one alkaline element can be replaced by another one under certain conditions. The clays that are chosen for drilling mud use, and

> those shales that are penetrated in the Gulf Coast, have very high mud-making ability, due to the predominance of sodium attached to the clay minerals. When that clay mineral is not attached, it has little or no mud-making ability. In the caustic soda-starch system, as the shales are incorporated in the drilling mud during the progress of drilling, their ability to make mud is reduced quite a bit by the presence of the caustic and the quebracho. The mud-making ability is depressed, I would say.
>
> In a system where calcium hydroxide takes the place of sodium hydroxide, we have **altered the nature of the clay** mineral by generating a calcium bentonite or a calcium clay, which mineral has little or no tendency to swell in water. We can therefore crowd in a higher percentage of shale cuttings in the calcium system than we can in the sodium system. That, translated into the cost of maintenance of the drilling mud in a well means a great reduction in the purchase of such items as starch, weighting material,* treating agents, and all of the many things that are bought to add to the mud. Both systems at pH 12 equally prevent fermentation of the starch."

Farnham then, App. 34, etc., Tr. 56, etc., gave the results of a series of tests, which are set out in a report, Px 4, App. 165, and Farnham actually **demonstrated** the difference in action by the jars, Px 4A and Px 4B, both containing a drilling fluid composed of clay with additions of gelatinized starch from 4 to 8 pounds per gallon, and with one treated with caustic soda, and with the other treated with lime.

Farnham first took Px 4 and particularly Table 1, which showed, that while in the **caustic soda**-treated drilling fluid the viscosity and gel strength were **high,** in the **lime** treated drilling fluid the viscosity and gel strength were

---

* A heavy powdered material such as barytes to prevent blow-outs.

low. Moreover, the filter loss or water **loss was lower** in the lime **treated** fluid as it was in the caustic soda treated fluid.*

Farnham then testified, App. 36, Tr. 58,

> "The lime-treated samples can have added to them substantial quantities of more clay of this same nature before being changed to characteristics similar to those in the 'B' column, that is, the higher viscosity and the higher gels, which means in oil drilling practice that the 'A' mud could have included a much greater burden of shale cuttings before you would have to have recourse to dilution of the mud or the purchase of mud materials to maintain the mud characteristics."
>
> "That is the same as we found in the field following the substitution of lime for caustic, a great reduction in the purchases required to maintain constant characteristics."

Farnham then took the two jars Px 4A and Px 4B, made up to correspond to the drilling fluid in column 3 of Table 1 of Px 4A, both containing 10% clay and 8 pounds of gelatinized starch, and both brought to the same pH of 12.1, one, Px 4A by **caustic soda** and the other by **lime.**** Both will give a water loss below 5, although the filter loss of the lime treated drilling fluid is **2.8**, while the caustic soda treated fluid is 3.9. However, the viscosity and gel strength of the **lime** treated fluid is **low** while that of the caustic **soda** treated fluid is **high.** In fact, Farnham testified, App. 37, Tr. 59:

> "The one containing soda, viscosity 103, is entirely too thick to use as a drilling mud."

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* The importance of keeping the viscosity down while still maintaining a low water loss was appreciated and discussed by this Court in its Opinion in the appealed case, 198 F. 2d 297.

** Unfortunately, Jar 4A corresponds to column B, while Jar 4B corresponds to Column A. But the diagram Px 4 is clear.

Farnham testified, App. 37-38, Tr. 60-61, that while the caustic soda treated fluid could be thinned down with water, that would reduce the weight which requires the use of additional weighting material, which is not required with the lime treated fluid.

Farnham, App. 38-39, Tr. 61-62, took the chart, Px 4, App. 167, and showed that while the **caustic soda** treated fluid has a low water loss with, however, a **high** viscosity and gel strength, the **lime** treated fluid had a **more favorable water loss,** particularly **in the vicinity of 5 cc** (included in claim 12), which is important in drilling practice, apart from the fact that the viscosity and gel strength are **low.** Upon inquiry by the Court, Farnham showed, App. 40, Tr. 64, that a very **low water loss is very important.** Farnham then testified, App. 40-41, Tr. 65-66:

> "Q. Coming back to comparison of the cost of the starch system and the lime-starch system, Plaintiff's Exhibit 4, third page, is there an advantage in having a low viscosity rather than having the viscosity run up high? A. The advantage of the low viscosity is that more shale solids can be included in the mud before you have to dilute the mud and build its weight up again.
>
> Q. How about the capability of control at the well? A. It is much **easier to control,** to maintain constant the lower viscosity muds than the higher viscosity muds.
>
> Q. Do the two systems indicated on those diagrams indicate a mere difference of degree between the two? A. I would say there is an **entirely different order of viscosity and gel characteristics** between the system that is treated with caustic soda, and the system that is treated with lime.
>
> Q. Is there a **difference in principle** of operation of the two systems? A. **Yes,** the principle of operation stems directly from the type of base that is at-

> tached to the clay mineral. In the one case it is the sodium clay, and in the other it is the calcium clay. **They act entirely different** in water systems.
>
> Q. Now, you get the same kind of clay in your drilling? In the two systems you come down to the same kind of clay? A. You are drilling through it.
>
> Q. In taking the two systems, you apply the caustic starch to the drilling fluid or apply a lime starch to the drilling fluid. Is the **resultant clay** content of the two drilling fluids the same or are they different? A. **They will be different.** You will be drilling through a clay that is predominantly a sodium clay. If it is incorporated in the system that is alkalized with caustic soda, it will remain a sodium clay. If it is incorporated in the one that is alkalized with calcium hydroxide, it will be changed to a calcium type of clay."

Farnham then testified App. 41, Tr. 66 that caustic soda is from **4 to 6 times** as expensive as lime; that caustic soda is most caustic, requiring the use of rubber gloves and goggles with chewing up of the clothes and burning of hands or legs, App. 32, Tr. 52-53; that caustic soda must be put in steel drums, Tr. 53, but that lime can be put in paper bags and can be handled by the driller with bare hands, because **lime** is only **1/50 to 1/70** as caustic as dry **caustic soda.** *

Farnham, one highly skilled in this art, App. 15, Tr. 27 testified App. 32, Tr. 52 that the **lime** gelatinized starch system has **replaced** the **caustic soda** gelatinized starch treatment by **4 to 1.** Farnham testified App. 48, Tr. 76-77:

> "Q. In your opinion—and I know you are employed by the Baroid Sales Division of National Lead Company—can you tell me whether or not this lime-starch system was or was not a substantial contribution to

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* See also Px 3, App. 159.

> the drilling art? A. I saw this after 1945, and we induced several people to use lime in place of caustic soda in the high pH system. Those that went to it stayed with it, so that **we replaced fully eight wells out of ten** in the high pH system, replacing caustic soda with lime, and the end result was a substantial saving to the drilling company. That replacement material was required to maintain the mud in the condition that they desired it during subsequent drilling."

This Is An Unusual Case.

Baroid Sales Division of National Lead Company is not in the well drilling business, but only sells materials to the drilling companies through distributing companies; it employs 250 engineers, who render service. However, although plaintiff has patents, oil companies are offered licenses to use the materials on a royalty basis which does not restrict them in the purchase of their materials. App. 20-21, Tr. 34-35.

We have previously referred to the fact that **lime** was considered in the nature of a poison for drilling fluids from 1932 on and was considered to be such at least as late as 1942.*

Farnham testified, App. 24, 27-28, Tr. 40-41, 46, that until **1945** the drilling art was **still fearful** of using lime in drilling fluids, that the art thought lime was **harmful** to the drilling fluid, that they thought it would ruin the mud.

Although in the application filed June 7, 1943, involved in the Appeal, Dx 2, App. 132, lime was mentioned for use in connection with gelatinized starch, and although one of the applicants, Beasley, had actually used it in

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* See In re Jones, 120 F. 2 1019, C. C. P. A., showing that a German publication, "Petroleum," as early as 1932, provided for the use of sodium bicarbonate to eliminate the bad effects of calcium hydroxide, found in cement, and the Chaney article, Px 3A, App. 160, which still considered calcium hydroxide as wholly undesirable in drilling fluids as late as 1942.

1941, App. 68, Dep. 12, the customers of Baroid Sales Division of National Lead Company were at that time fearful of using lime, Farnham, App. 28, Tr. 46. It was not until 1945, App. 31, Tr. 50-51, that Baroid Sales Division engineers were finally able to persuade drillers to use lime with gelatinized starch in two wells, one near Houston, and the other in East Texas. Farnham testified, Tr. 51-52:

> "**Q.** How did it work? When they added lime to get a pH of about 12, and then added starch, what happened? **A.** We could maintain the high pH with lime as well as they had formerly done with caustic; we could greatly reduce the viscosity-contributing effect of clay colloids that were drilled up during the course of drilling. That greatly reduced the amount of maintenance materials that had to be purchased to hold the drilling mud at constant condition.
>
> **Q.** That was in 1945, about seven years ago. What has happened since that time? Comparing the two systems now as you have observed them being used in the field, and as you get reports, what are the relative percentages of the caustic starch and the lime starch systems that are used today? How are they divided, in what proportion? **A.** I would say that in the wells using high pH starch systems, at least 80 percent of them employ calcium hydroxide, and less than 20 percent of them employ sodium hydroxide to maintain that high pH.
>
> **Q.** Did you have difficulty in getting people to use the lime-starch system? **A.** We did at first, yes, but once we achieved success with it and could talk about that, we applied it to similar wells."

THE STATUTE INVOLVED.

The Statute involved is the familiar one, R. S. 4915; 35 U. S. C. 63.

STATEMENT OF POINTS.

(1) The testimony adduced at the trial shows clear error on the part of the Patent Office in refusing a patent to Plaintiff with the claims in suit and the claims define invention and are patentable over the prior art.

(2) The Stern Bureau of Mines Bulletin does not disclose the subject-matter of the claims in suit and it does not disclose a well-drilling fluid containing gelatinized starch, maintained at a pH of about 12 by addition thereto of lime.

(3) The Cannon patent 2,109,858 does not disclose the subject-matter of the claims in suit and does not disclose a well-drilling fluid containing gelatinized starch maintained at a pH of about 12 by addition thereto of lime.

(4) The application in suit and the claims thereof involve a discovery in a process of treating well drilling fluids and not simply properties of the well drilling fluids of the Stern Bulletin and of the Cannon patent.

(5) Plaintiff is entitled to a patent on the application in suit involving the claims thereof.

SUMMARY OF ARGUMENT.

The application in suit relates to the art or process of drilling wells by an aqueous well-drilling fluid, in which an amylaceous emulsoid colloid, i. e., gelatinized starch, is added to seal the walls of the bore-hole. The characteristic feature resides in maintaining the alkalinity of the drilling fluid containing gelatinized starch, at a pH of about 12 by addition thereto of an alkaline-earth metal oxide, viz., lime, in order to inhibit deterioration of the gelatinized starch and so as to maintain a wall seal at a low water-loss, viz., 5 cc.

The Patent Office has not cited any prior art disclosing the subject-matter of the claims in suit.

> The Stern Bulletin, App. 151, discloses gelatinization of raw starch by caustic soda and the addition thereof to the drilling fluid. It does not disclose a drilling fluid maintained at a pH of about 12 by an alkaline-earth metal oxide, viz., lime.
>
> The Cannon patent 2,109,858, App. 147, discloses a drilling fluid containing quebracho (a tannin), together with caustic soda in an amount sufficient to attain a pH in excess of 12. The patent mentions the use of starch, but not gelatinized starch, as a substitute for quebracho. The patent also mentions the use of lime as a substitute for caustic soda. However, while caustic soda will gelatinize starch, lime will not gelatinize starch. Accordingly, the substitution of starch for quebracho and the second substitution of lime for caustic soda, will not produce a drilling fluid containing gelatinized starch because lime will not gelatinize starch.

The process of the application in suit constitutes a distinct improvement over a process where caustic soda is employed to maintain a drilling fluid, containing even gelatinized starch, at a high pH. The drilling fluid of the application, which is maintained at a high pH by lime, is an entirely different drilling fluid, than one where caustic soda is used; for the action of lime is entirely different than is the action of caustic soda and involves a different principle of operation. This process enables a lower water-loss to be attained while keeping the viscosity and gel strength within limiting values. This process enables the cost of drilling fluid and of the materials used therein to be kept low. This process enables easier control of the drilling fluid. This process constitutes a substantial contribution to the well-drilling art and has replaced the process where caustic soda is used on a 4 to 1 basis. This process is also safer, in that while caustic soda is exceedingly caustic and harmful to the drillers' persons and their clothes, lime is a mild material and can be safely handled.

The history of the art shows that the use of lime instead of caustic soda in a drilling fluid was not obvious. Since 1932 lime has been considered detrimental to well-drilling fluids to such an extent that drillers, even as late as 1945, were afraid to use it because of its effects on the clays. Where lime was encountered, special treatments by sodium bicarbonate were resorted to to get rid of the lime. After the commercial production of this process, beginning in 1945, it has practically replaced the process employing caustic soda.

The District Court disregarded the testimony of four highly skilled in this art witnesses supported by actual tests and by authoritative literature. That testimony was not disputed by the Commissioner's counsel at the trial. The opinion of the District Court and the Findings of Fact of the District Court are not supported by the evidence, but are contrary to the evidence. The Conclusions of Law of the District Court are not supported by law, but are contrary to law, particularly as construed by the Supreme Court and by this Court.

ARGUMENT.

The questions before this Court are: Were Sikes and Beasley the first to employ their process and is that process patentable as a process as set forth in the complete claim 12, viz.:

> 12. In the art of drilling wells through formations by the employment of an aqueous mud-laden well-drilling fluid containing an **amylaceous emulsoid** colloid which is subject to deterioration during the course of drilling, the process, comprising, maintaining such a drilling fluid, during the course of drilling, at a pH of about 12 by addition thereto of an **alkaline-earth metal oxide** in order to inhibit such deterioration, and maintaining the drilling fluid during the course of drilling, at a **water loss** of about **5 cc** by addition thereto of the amylaceous-emulsoid-colloid.

The expression "amylaceous-emulsoid-colloid" is gelatinized starch, Px 1, App. 77. The "alkaline-earth metal oxide" given in the specification and in the examples is lime, either in the form of calcium oxide or calcium hydroxide. The pH of **5 cc** is defined in the specification as one giving "a low water loss," App. 85, and it is **in that zone** where applicants' drilling fluid is not only **vastly superior** to a drilling fluid employing caustic soda at low viscosities, Px 4, App. 165, but produces **an entirely new drilling fluid**, Px 1, App. 80.

In order to meet that claimed process two things must concur, namely: (1) The emulsoid colloid used must have been **gelatinized** starch, not simply starch; (2) The pH of about 12 must have been attained and even maintained **by lime.**

The Stern Bulletin obviously cannot meet that claimed process, because there the starch is converted to gelatinized starch by **caustic soda** and the pH was therefore attained by caustic soda, **not by lime;** accordingly, (2) is not disclosed.

The Cannon patent likewise cannot meet that claimed process; for as shown, when quebracho is replaced by starch and caustic soda replaced by lime, then the **starch will not be converted to gelatinized starch;** accordingly (1) is not attained. The most that could be attained by Cannon if he employed lime with starch was only (2) which will, however, **render the fluid useless** as a well drilling fluid, because lime will simply deflocculate the clay. **It is only when lime is used with gelatinized starch that a useful result is attained; that is the invention of Sikes and Beasley.**

It would seem fundamental that if a prior art instance relied upon by defendant in the manner relied upon will not produce the later claimed invention, then it cannot be a bar under R. S. 4886, 35 U. S. C. 31.

Coffin v. Ogden, 18 Wall. 120, applied the prerequisites under R. S. 4888, 35 U. S. C. 33, to a prior art citation. The Supreme Court said:

> "The invention or discovery relied upon as a defense must have been complete and capable of producing the result sought to be accomplished; and this must be shown by the defendant. The burden of proof rests upon him, and every reasonable doubt should be resolved against him. If the thing were embryotic or inchoate; if it rested in speculation or experiment; if the process pursued for its development had failed to reach the point of consummation it cannot avail to defeat a patent founded upon a discovery or invention which was completed, while in the other case there was only progress, however near that progress may have approximated to the end in view. The law requires not conjecture, but certainty." p. 124.

In **Moffett v. Fiske**, 60 App. D. C. 281, 51 F. 2d 868, this court applied R. S. 4888 to a patent in suit. This Court, in holding the patent invalid because inoperative, and citing Coffin v. Ogden, said, p. 872:

> "In fact, the plaintiff testified that his invention 'was a pure dream embodied in the descriptions and drawings,' and that he was amazed at the facility with which a patent was obtained for a thing so obvious.
>
> "We think his amazement was justified; but a dream, like an idea, is not an invention, and cannot be patented until embodied in a physical contrivance making it practically useful.
>
> "Until the inventor has done this as a matter of reasonable legal certainty, and **not** as a matter of mere conjecture or prophetical possibility, he has given nothing to the public in return for the monopoly which he seeks by letters patent."

It is apparent that when the Cannon patent be considered by substituting starch for quebracho and lime for caustic soda, then Cannon will **not** be "capable of producing the result sought to be accomplished" by Sikes and Beasley, which is "founded upon a discovery or invention which was completed." That will **not** make any modified Cannon process "practically useful." The position of the Patent Office is simply based upon "mere **conjecture** or prophetical possibility," which we have proved is an impossibility and which the Patent Office has not disputed.

In this case, at most, Cannon mentions lime simply as **a possible variant** of caustic soda in the examples in which the alkaline material is caustic soda and not lime; but that will not make something useful, but useless.

Becket v. Coe, 69 App. D. C. 53, 98 F. 2d 332, involved "a stain-resisting iron-base alloy having deep drawing properties." p. 333. It was an iron-base alloy containing in addition to iron, chromium, manganese, nickel and copper. There, as here, prior patents were relied upon which **did not have as their object** the production of a stain-resisting alloy having deep drawing properties, and some of the patents contained **general statements** which were relied upon by the Patent Office as disclosing Becket's invention. The following language of the Court is particularly pertinent here:

> ". . . A careful reading of the patent, however, convinces us that so far as a chromium-manganese-nickel-copper ferrous alloy is concerned the inventor was but **guessing in the dark.** This type alloy is mentioned **only as a variant** of a chromium-nickel-manganese alloy, with neither details as to what different results would be obtained, nor any indication that the metal would resist staining." p. 335.
>
> ". . . With the Becket application before us it is possible to look back upon the Hadfield (French) and Commentry (French) patents and to say that they suggested what he found, but such hindsight should not, we think, defeat his application. Hadfield and Commentry seem neither to have sought nor to have found an alloy which is both stainless and deep-drawing, and though it be true that the scope of their ranges embraces the claims of Becket, this speaks of the extent of their **desire** rather than of the breadth of their discoveries." p. 336.
>
> ". . . One seeking a stainless deep-drawing alloy and finding the Hadfield (French) and Commentry (French) patents could not have said: **'These give me what I want.'** " p. 336.

The Cannon patent "was but guessing in the dark"; it speaks only of lime as **"a desire"**; it certainly cannot be said that lime will "give me what I want"; in fact we have shown the opposite. Any modification of the Cannon process in the manner which the Patent Office attempts to do, will result in **something useless**, certainly not the highly useful process of Sikes and Beasley.

There can be no doubt that the Sikes and Beasley process is an art or process under the law.

Corning v. Burden, 15 How. (56 U. S.) 252, discusses the fundamental attributes of a process as follows, 267-268:

> "A process, eo nomine, is not made the subject of a patent in our act of Congress. It is included under the general term 'useful art.' * * * But where the result or effect is produced by chemical action, by the operation or application of some element or power of nature, or of one substance to another, such modes, methods, or operations, are called processes. A new process is usually the result of discovery; a machine, of invention. * * * It is for the discovery or invention of some practicable method or means of producing a beneficial result or effect, that a patent is granted, and not for the result or effect itself. It is when the term process is used to represent the means or method of producing a result that it is patentable. * * *"

That case has been consistently followed by the Supreme Court and by this Court; thus in **Kelley v. Coe**, 69 App. D. C. 202, 99 Fed. 2d 435, this Court said, 441 footnote:

> "A process is a mode, method, or operation, whereby a result or effect is produced. Corning v. Burden, 15 How. 252, 14 L. Ed. 683. 'A patentable process is a method of treatment of certain materials to produce a particular result or product.' Holland Furniture Co. v. Perkins Glue Co., 277 U. S. 245, 255, 48 S. Ct. 474, 478, 72 L. Ed. 868."

From the above, it will be seen that a patentable process is not only characterized by the mode, method or operation, i. e., the procedure, but also by **the effect or result produced.** Of course, the result or effect per se is not patentable, but what is patentable is the "method or means of producing a beneficial result or effect" or "whereby a result or effect is produced"; Corning v. Burden, and Kelley v. Coe, supra.

The Sikes and Beasley process is a mode of procedure which is distinct and produces an entirely new well drilling fluid; that was not disputed by the Patent Office.

In Carnegie Steel Co. v. Cambria Iron Co., 185 U. S. 403, the Supreme Court said:

> "In other words, a process patent can only be anticipated by a similar process. A mechanical patent is anticipated by a prior device of like construction and capable of performing the same function; but it is otherwise with a process patent." p. 424.
>
> "This proposition that the application of this patent depends upon the individual intent of the operator overlooks the essential nature of a process patent. The directions and specifications of such a patent are addressed to those engaged and skilled in the art. It professes to disclose a method of procedure, not the particular instrumentality that may be employed." p. 441.

Kelley v. Coe, 69 App. D. C. 202, 99 F. 2d 435, involved p. 441 a procedure in rock drilling, involving maintaining a negative or sub-atmospheric pressure in the hood at all times during operation; and the prior art did not recognize the necessity for permitting free entry of air under conditions of sub-atmospheric pressure in the hood. Kelley himself had first worked on the theory of the prior art and failed. This Court said:

> ". . . And it was not until the theory of operation described in Kelley's method was understood by those who had failed in their efforts to use the Prellwitz method in the light of the prior art, that they realized the fundamental defect of the Prellwitz method and the reason for its failure. In order that a reference

> or group of references may teach a process, the process must be deliberate and the means understood." p. 441.

Here the Patent Office tribunals have "failed in their efforts to use" both Cannon and Stern as bars against the Sikes and Beasley process because their process is "deliberate and the means understood," while that simply cannot be true of any attempted application of the Cannon patent and of the Stern publication.

The Mathieson Alkali Works v. Coe, 69 App. D. C. 210, 99 F. 2d 443, involved a process of bleaching cellulosic materials with an acid solution containing a chlorite of a metal. In the prior art hypochlorites had been employed, and the Patent Office took the position that they acted the same way. This Court, in holding that the patent should issue, says, p. 444:

> ". . . The reference discloses nothing concerning the bleaching of cellulosic materials, and discloses nothing concerning the different reactions of chlorites and hypochlorites in an acid solution . . ."

Here Cannon says nothing concerning the effects of lime in a drilling fluid containing starch, and as we have demonstrated, lime will simply not gelatinize the starch, but at most will only raise the pH, resulting in flocculation of the clay solids, which is what the art has been trying to avoid, by wholly avoiding the use of lime, and when it got into the drilling fluid, neutralizing it with sodium bicarbonate, all as early as 1932 and as late as 1945.

The Position of the Patent Office as Affirmed by the District Court Is Without a Reasonable Basis and Is Illogical.

Throughout the presentation of the case by the Patent Office Examiner Dx 1-D App. 122, and by the Board of

Appeals Dx 1-F App. 126, and finally by the District Court App. 6, the argument is that **lime is just another alkaline material**, which will raise the pH of a drilling fluid and therefore is a substitute for caustic soda. Of course, that was known a long time ago, indeed as early as 1932, but the art immediately took steps to neutralize the lime if it got into the drilling fluid, by the application of something which would reduce the pH. That something was sodium bicarbonate which would reduce the pH to 8.4 Dx 3 App. 156 and Px 3-A, App. 160.

In the second Examiner's statement, Dx 1-E App. 125, as to the citation of the Offeman affidavit Px 1, App. 94, showing that lime will not gelatinize starch, the Examiner did not question that, but he simply takes that as showing "the differences in action between caustic soda and lime," which he states "is not the point in issue," because "the Examiner has not questioned the equivalence of sodium hydroxide and lime." That is indeed a strange position to take, because the Examiner's idea of equivalence relates only to whether or not lime and caustic soda will both raise the pH of a drilling fluid, which we have not disputed. However, the Examiner has entirely ignored the **second factor**, namely, whether lime will gelatinize starch.

An equivalent was long ago defined as something which:

> "Performs substantially the same function in substantially the same way to obtain the same result."

That is the definition given in Machine Co. v. Murphy, 97 U. S. 120, 125, later quoted with approval in Sanitary Refrigerator Co. v. Winter, 280 U. S. 30, 42. Lime simply cannot be an equivalent of caustic soda when it comes to the **second factor** of gelatinizing starch, because lime will not do it at all, so that any attempted application of the Cannon patent will result in something inoperative.

The decision of the Board of Appeals, Dx 1F, apparently saw the weakness of the Examiner's position; for the Board **stepped outside of the prior art** and relied upon a statement in applicant's copending application that gelatinization of starch will take place in a deep well. We have shown where that is illogical because as Farnham shows, see p. 8, supra: first, those temperatures are only encountered in one out of ten wells, so that any gelatinization is purely accidental; second, that starch will not be gelatinized by lime at any temperature. Finally, as a matter of law, applicants' own statement in their own co-pending application can certainly not be relied upon as prior art under R. S. 4886, 35 U. S. 31.

The Board of Appeals then switched to Radley's publication, Dx 1, and argues, App. 130, "that starch will undergo gelatinization with **alkalies** at room temperature." We want to note, however, that the Board did not make any quotation from Radley's book. **We** therefore challenge the Commissioner's counsel to show where Radley has reference to lime, calcium oxide, calcium hydroxide or any other alkaline-earth oxide or hydroxide. We find none. The only reference to any alkali is "caustic soda" recited three times in Radley's book, page 265.

Here the Board of Appeals simply sidestepped the issue which we have here, namely, whether or not in accordance with the Cannon process, starch will be gelatinized by lime as well as raising the pH.

The District Court's decision is along the lines of the statement by the Examiner, that the distinction of this case over appealed case is that lime is used instead of another alkali, although a basis of the opinion of this Court was that caustic soda would gelatinize starch; further, that this case simply involves an increase of knowledge of the procedure of the drilling fluid, when such is not the case at all, because it involves a new process; further that the case here simply is one of selection of lime to control the pH, although all that will happen by substitution of lime for caustic soda in the Cannon process will be something inoperative.

We realize that this Court has hesitated to overrule the Patent Office and the District Court on a question of inventiveness. This Court refused to do so in the preceding case Appeal 10,873, because this Court found that when Cannon substituted starch for quebracho, then **with caustic soda present:** (1) starch would become gelatinized by the caustic soda; (2) the pH of the drilling fluid would be at least at 12.

This Court therefore held that the broad process in that Sikes and Beasley application, broad enough to cover the employment of **any** alkaline material (which included **caustic soda**) was **inherently performed.** However, that is not the case here because (1) will not be performed if lime be substituted for caustic soda in accordance with the Cannon patent.

In **Broderson v. Marzall,** 89 App. D. C. ...., 194 F. 2d 138, this Court in reversing the Patent Office as well as the District Court says:

> "This court has long hesitated to overrule the findings of the Patent Office and the District Court on a question of inventiveness. We hesitate to do so now. In fact, in Abbott v. Coe, we pointed sharply to the rule that we will not disturb the findings of the Patent Office upon a question of inventiveness if those findings are, in our view, reasonable upon the record. Nevertheless, when our view of the record has required it, we have reversed. Thus we did so in Poulsen v. Coe, two of the three judges who sat in Abbott v. Coe participating, and likewise in Levin v. Coe, again two of the three judges who sat in Abbott v. Coe participating."

This case is, of course, filed under R. S. 4915 where the Court

> "May adjudge that such application is entitled, according to law, to receive a patent which is invention, as specified in his claim or for any part thereof **as the facts in the case may appear.**"

The facts in this case show, that any attempt to modify the disclosure of the Cannon patent and of the Stern publication will not result in the performance of the Sikes and Beasley process, nor produce their distinctly novel well drilling fluid, but will produce something which will be **inoperative.**

This Court has applied Abbott v. Coe and reversed the Patent Office and the District Courts in the following recent cases:

Switzer v. Marzall, 94 F. Supp. 52, decided by Judge Keech, was recently affirmed by this Court, 199 F. 2d 776. That case involved a process of dyeing fabrics by dissolving a light fluorescent dye in strong aqueous alcohol and immersing the fabric in such solution. The Patent Office relied upon a Paine patent for securing fluorescence by ultraviolet light and a Rhodiaseta patent for communicating to cellulose acetate an affinity for dyestuffs.

The District Court in quoting from Becket v. Coe (98 F. 2d 332, 336) said, 94 F. Supp. p. 53:

> "Would a man who was grappling with the problem solved by the patent attacked, and having no knowledge of that patent, if he had had the alleged anticipation in his hand, have said: 'That gives me what I wish?' "

In finding the subject matter patentable said, pp. 53-54:

> "I find that the plaintiff's process, while utilizing certain materials and processes made known by prior

> patents, attains a new result, namely, daylight fluorescent fabrics, or, at the least, substantially enhanced qualities of utility, namely, fluorescence of fabrics enhanced to a degree never before conceived of, and does exhibit the necessary spark of genius; and that therefore plaintiff is entitled to a patent."

There can be no doubt that this case involves not only **a new combination in a process**, but something which attains a new result, namely, **an entirely new drilling fluid,** which at the same time is maintained against deterioration of the gelatinized starch.

This Court, in affirming Judge Keech on the Commissioner's Appeal, said, 199 F. 2d p. 777:

> "The applicable rule as to the use of known elements to achieve a new and useful result has been stated recently by the Supreme Court in A. & P. Tea Co. v. Supermarket Corp. and by this court in Broderson v. Marzall."

In Broderson v. Marzall, 89 U. S. App. D. C. ..., 194 F. 2d 138, this Court said:

> "As this court pointed out in Levin v. Coe, supra, it is settled that the fact that all of the elements entering into a combination are old does not necessarily negative the existence of invention. So **the possibility** of invention in the case before us is not blocked by the fact that the elements used are not new. We think that, by merely pointing out that the several elements were old, not indicating in even the slightest respect wherein the new and novel combination here claimed was revealed or indicated to such an extent as to make it producible by the use of mere skill in the art, the Patent Office did not lay a supportable basis for rejection of this patent."

Levin v. Coe, 76 App. D. C. 347, 132 Fed. 2d 589, involved a process of treating grain germs to extract therefrom substantially all of the oil **without** affecting its vitamin content. This Court said, p. 591:

> "The position of the Commissioner is that to obtain the appellant's product it is only necessary to follow Hoffman's use of a hydrocarbon solvent in freeing the wheat germ from oil and then to remove the solvent from the residue constituting Hoffman's intermediate product."

There one reference was relied on to extract the oil but the end product was a sugar and did not retain the wheat germ. This Court said, p. 597:

> "Under the uncontradicted evidence the appellant's process for the first time combined the elements of the prior art and achieved a new result, a wheat germ product palatable for human consumption and stable."

Under the facts as they appear in this case, the situation is rather closely analogous to the situation in **Poulsen v. Coe** in 73 App. D. C. 324, 119 F. (2d) 188, which involved a process relating to the recording of sound on films used in the making of moving pictures. A prior Robinson and Hewlett patent was relied on, but was found wanting by this Court reversing the District Court, this Court said, p. 197, left:

> "We think that the appellants' improvement was not anticipated in Robinson and Hewlett and that the rejection by the trial court and the Patent Office was demonstrably the result of clear **error** in respect of the **foundation** for rejection."

The attitude of the Patent Office is stated by this Court, p. 197, right:

> "Apparently the Patent Office was **misled,** in respect of anticipation of the appellants' device and method by Robinson and Hewlett because, in its comparison of the appellants' device with that of Robinson and

> Hewlett, its **attention** was in the large **concentrated** upon the elimination of background noise rather than upon the solution of the problem of asymmetrical distortion."

That applies to this case, because the Examiner in his statements considered this case **only one of using lime to increase the pH** of a drilling fluid, overlooking entirely the fact that one of the things which Sikes and Beasley did was to **convert the clay fluid to something entirely new** as described in the specification, PX 1, App. 80.

This Court observes p. 198 left-right:

> "Had the attention of the Patent Office been directed **not merely to the elimination** of background noise but to the whole of the appellants' accomplishment, i. e., the solution of the problem of **asymmetrical distortion without sacrifice of the advance of the art in respect of background noise,** it must have noted the crucial difference between the process and apparatus of the appellants and that of Robinson and Hewlett."

That applies here because Sikes and Beasley maintained the pH necessary to prevent fermentation of a clay starch drilling fluid **without sacrifice** of advancing the art with respect to the drilling fluid itself, which, by the addition of starch is reduced to the **ideal form,** namely, **low viscosity and gel strength.** On the other hand, where caustic is used, thinners must be employed, see pp. 13-14, supra.

This Court then said, p. 199, left:

> "Putting this more concretely: if the appellants were to solve the problem of distortion and **at the same time** retain for the art the advance made by Robinson and Hewlett, they must go **contrary** to the teaching of the art as it stood under Robinson and Hewlett."

That certainly applies here because Sikes and Beasley both **went contrary to the art for over a decade** prior to their invention, which taught that lime should under no circumstances be used.

This Court then said, p. 199, left:

> "We think it took that boldness, clarity of vision and ingenuity characteristic of invention, as distinguished from mechanical skill, to attempt the voyage upon which the appellants set out and to sail it successfully so that at the end both the Scylla of distortion and the Charybdis of background noise were eliminated for the future of the art."

Here Sikes and Beesley certainly sail successfully so that at the end the Scylla of **fermentation** and the Charybdis of **flocculation** of the drilling fluid were eliminated.

In other words, here as in the Poulsen case, there is a **combined two-fold effect** when lime and gelatinized starch are added to a clay-laden well drilling fluid.

This Court, in reversing the District Court, then said, page 200, left:

> "Since in our view the findings and conclusions of the trial court and the rulings of the Patent Office were in clear error on the question of anticipation, and since we think it clear also that the appellants' advance was inventive in character, we are obliged to reverse in respect of claims 72, 73, 74, 76, 77, 78 and 79. Abbot v. Coe, 1939, 71 App. D. C. 195, 109 F. (2d) 449."

Poulsen v. Coe so thoroughly applies to this case that further argument is really unnecessary. It was cited with approval in Broderson v. Marzall, 89 App. D. C. ..., 194 F. 2d 138, supra, which was in turn cited with approval in Marzall v. Switzer, App. D. C., 199 F. 2d, p. 777, supra, p. 32.

It is therefore respectfully submitted that this Court is warranted to reverse the District Court and authorize the Commissioner of Patents to issue a patent on the application in suit on the claims in issue.

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For the
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BRIEF FOR APPELLEE

United States Court of Appeals

FOR THE DISTRICT OF COLUMBIA CIRCUIT

APPEAL No. 11735

NATIONAL LEAD COMPANY, APPELLANT
v.
ROBERT C. WATSON, COMMISSIONER OF PATENTS,
APPELLEE

APPEAL FROM THE JUDGMENT OF THE UNITED STATES DISTRICT COURT FOR THE DISTRICT OF COLUMBIA

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STATEMENT OF QUESTIONS PRESENTED

In the opinion of appellee the questions presented by this appeal are:

(1) Whether appellant is entitled to a patent containing claims which differ from claims previously held unpatentable by this Court only in specifying a particular class of materials, the alkaline earth metal oxides, for attaining the specific alkalinity needed (pH 12) to prevent deterioration of a drilling mud composition containing pre-gelatinized starch, the prior claims held unpatentable having defined the use of a caustic alkali broadly for the same purpose, where the prior art clearly disclosed that lime, appellant's preferred material, could be used for producing a highly alkaline mud drilling fluid, and the ability of lime to produce a solution of pH 12 was a matter of common knowledge to chemists;

(2) Whether appellant is entitled to a patent defining a class of materials for obtaining a stated result, where the record shows that one specific material within the defined class is inoperative and incapable alone of accomplishing the claimed result, or whether, under such circumstances, the claimed subject matter is unallowable under R. S. 4888 for overclaiming.

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FOR THE DISTRICT OF COLUMBIA CIRCUIT

APPEAL NO. 11735

NATIONAL LEAD COMPANY, APPELLANT
v.
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APPELLEE

APPEAL FROM THE JUDGMENT OF THE UNITED STATES DISTRICT COURT FOR THE DISTRICT OF COLUMBIA

BRIEF FOR THE COMMISSIONER OF PATENTS

INTRODUCTION

This is an appeal from the judgment (A. 12)[1] of the United States District Court for the District of Columbia, dated December 24, 1952, dismissing appellant's complaint (A. 1 to 4) against appellee, Commissioner of Patents, in an action pursuant to Section 4915 of the Revised Statutes [35 U. S. C. (1946 Ed.), 63], Civil Action No. 234–51, in which appellant sought to have the District Court issue an order authorizing the Commissioner of Patents to grant letters patent of the United States to appellant, based upon certain claims of the Sikes and Beesley patent application, Serial No. 635,716, filed March 11, 1946, on an alleged invention in the "Treatment of Well Drilling Fluids." The complaint was dismissed because the claimed subject matter is clearly non-inventive in view of the prior art. (Finding of Fact No. 11—A. 12).

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[1] The numbers in parentheses refer to pages of the joint appendix.

Defendant, John A. Marzall, named in the complaint (A. 2) was succeeded as Commissioner of Patents by Robert C. Watson on February 18, 1953, after the notice of appeal to this Court was filed, but prior to the filing of the record herein, and said Watson was timely substituted in his official capacity as party defendant, on March 12, 1953.

THE APPLICATION

The specification of the application involved in these proceedings states that the instant application is a continuation of application Serial No. 489,890, filed June 7, 1943, as to common subject matter (A. 77). That application was also involved in proceedings under R. S. 4915, and, as pointed out in the trial Court's opinion (A. 6), the District Court held that the plaintiff, appellant here, assignee also of the prior application, was not entitled to letters patent on the claims there involved, for the reason that the claims did not define invention over the disclosures of the prior patent to Cannon, 2,109,858, granted March 1, 1938, and the prior publication of Stern, Bulletin No. R. I. 3556, Bureau of Mines, Dept. of Interior, dated February 1941. On appeal, this Court affirmed, 198 F. 2d 296, and a rehearing was denied September 4, 1952.

As stated in the opinion of the trial Court (A. 7), appellant asserts patentability here for a method of drilling a well which involves the use of a mud composition containing an amylaceous emulsoid colloid (gelatinized starch) at a pH (alkalinity) value of about 12, the pH value being obtained by the use of an alkaline earth metal oxide. While lime is the preferred material for obtaining and maintaining this pH value, the specification also states that oxides or hydroxides of magnesium, barium or strontium may be employed (A. 79).

THE CLAIMS

The claims at bar are those numbered 11 to 15, inclusive (A. 86, 87). Claim 11 was considered representative by the trial Court (A. 7). A casual inspection thereof shows that invention is asserted for a method of drilling a well which involves the use of a mud composition containing an amylaceous emulsoid colloid which comprises maintaining such a mud, during the course of drilling, at a pH of about 12 by the addition thereto of an alkaline earth metal oxide. Claim 12 adds to the process of claim 11, the step of maintaining the mud at a water loss of 5 cc. by the addition of amylaceous emulsoid colloid. Claim 13 particularizes on the order of adding the materials to the mud composition, namely, that the alkaline earth metal oxide is added to bring the composition to a pH of about 12, then the amylaceous emulsoid colloid is added, and, finally, that the composition is maintained during the course of drilling at such pH. Claim 14 defines only the steps of bringing the mud composition containing the colloid to the pH of about 12 by the addition of an alkaline earth metal oxide, and then maintaining such pH during drilling. Claim 15 is more specific than claim 14 in calling for the step of adding an amylaceous emulsoid colloid after the composition has been brougth up to a pH of about 12. It should be noted that only claim 11 specifies that the pH is maintained during the course of drilling by the addition of an alkaline earth metal oxide; all other claims recite that such compound is used to bring the composition up to the pH of 12, but are silent as to what material is used to maintain that pH during the course of drilling.

THE PRIOR ART

The patent to Cannon, 2,109,858, granted March 1, 1938 (A. 147) adds to an ordinary drilling mud composition an alkaline material, which may be caustic soda, caustic potash or lime (p. 1, col. 2, lines 53, 54), and an organic compound, which may be tannic acid, humic acid, pyrogallic acid, gallic acid, sugar or starch (p. 2, col. 1, lines 2–5). As to this patent, this Court, in the prior suit, found that Cannon discloses a drilling mud composition including starch and caustic soda, which in the concentration used (1%) will produce a hydrolyzed or gelatinized starch and a pH value just under 13.0 (A. 8).

The publication of Stern (A. 152) describes the use of starch in drilling muds, and teaches that a mud containing a pre-hydrolyzed or gelatinized starch maintained at a pH value of 11 or 12 is desirable.

The table of pH values of various acids and bases (A. 156), reproduced from "Modern pH and Chlorine Control", was cited by appellee in connection with the contention made below that the claims sought are unpatentable also because they are unduly broad.

SUMMARY OF ARGUMENT

1. The application for patent at bar is a continuation as to common subject matter of a prior application of apellant, the claims of which were held unpatentable over the prior art by this Court in *National Lead Co.* v. *Marzall*, 198 F. 2d 296. The Court's rulings upon the prior art and upon the question of non-patentability of the sub-

ject matter are conclusive upon the parties; they are the law of the case on those questions.

2. The subject matter held unpatentable there and the subject matter claimed here are closely related. The claims held unpatentable called for the use of a caustic alkali for establishing and maintaining the pH value of a mud drilling composition containing a pre-gelatinized starch at about 12. The claims at issue here call for the use of an alkaline earth metal oxide to accomplish the same result. Consequently, these claims are directed to a species of caustic alkali, whereas the claims held unpatentable in the prior case called for alkali broadly. Inasmuch as the prior art had available to it the knowledge of what materials would produce a pH value of about 12, and lime, a particular alkaline earth metal oxide, was known for that purpose, the selection of any particular material from the known list does not rise to the dignity of invention.

3. The advantages alleged to flow from the use of lime, particularly as compared with other alkalis, caustic soda, for example, are insufficient to make for patentability, first, because those advantages were not disclosed in the application, and, second, because the application discloses that caustic soda and lime are essential equivalents. The additional argument that appellant was doing something that the prior art avoided is without merit, first, because the prior application disclosed that lime could be used and did not indicate that it was detrimental, and, second, because the suggested use of that material in the Cannon composition is indicative of the fact that some of those skilled in the art did not believe that the use of lime was to be feared.

4. Commercial success is of no significance here when the new material is less caustic and less expensive than the old. Replacement would be the natural result, and there is no doubt that the substitution of lime for caustic soda would be obvious and non-inventive.

5. The record shows that at least one alkaline earth metal oxide, magnesia, is inoperative. The claims are unallowable under R. S. 4888 for overclaiming.

THE ARGUMENT

In view of the decision of this Court on appellant's prior application—*National Lead Co. v. Marzall,* 198 F. 2d 296—it is evident that the Court's findings as to the disclosures of the prior art, and the conclusion that such disclosures negatived patentable invention in the subject matter there claimed, are conclusive against appellent here. In other words, those rulings have established the law of this case on those questions of fact and conclusions of law.

Looking to that decision it is crystal clear that this Court held that a drilling mud composition which contained hydrolyzed or gelatinized starch maintained at a pH of about 11.0 or 12.0 was described in the Stern publication; that the Cannon drilling composition contained starch and caustic soda which, in a 1% concentration, would gelatinize the starch and produce a solution having a pH value of just under 13.0; that the only thing missing from the aggregate of these prior disclosures of Cannon and Stern, which appellant supplied, was the discovery that gelatinized starch could be prevented from deteriorating in a drilling fluid by maintaining the alkalinity of the latter at about 12.0; and that patentability could not be predicated upon the discovery or determination of that

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fact, since increase in the knowledge of the properties of an old composition did not call for the grant of a patent.

Hence, the primary question presented by this appeal is whether additional factors are present in the claims at bar, which would make these claims patentable over the same prior art. Finding of Fact No. 6 (A. 11) states that the only difference is the statement that an alkaline earth metal oxide is used to bring the pH value of the fluid to about 12 or to maintain the pH value at about 12 during the course of drilling.

Inasmuch as the claims at bar differ from the claims held unpatentable in the prior case only in the use of an alkaline earth metal oxide to attain the desired alkalinity—pH 12—it is submitted that these claims too define nothing novel or inventive over Cannon and Stern to justify their allowance. Cannon clearly teaches (p. 1 col. 2, lines 52–55) the equivalency of caustic soda and lime, which is a particular alkaline earth metal oxide, i. e., calcium oxide, for obtaining the high alkalinity desired in the drilling mud, in addition to teaching that any alkaline material of sufficient alkalinity could be used. Appellant's prior application also disclosed the equivalency of caustic soda and lime for this purpose (A. 137). In addition, the art was fully conversant with the nature of those alkalis or bases which could give a pH value of about 12, as clearly appears from the Table of pH Values of Bases (A. 156). In the light of the teachings of Stern that the drilling mud should contain a pregelatinized starch and should be maintained at a pH value of about 11 or 12, it is submitted that the selection of any material from the table showing the pH values of various bases capable of yielding a solution of pH value about 12 would not be invention under the doctrine of *Sinclair and Carroll Co.* v. *Interchemical Corp.*, 325 U. S. 327. Moreover, lime, an alkaline earth metal oxide, is specifically named by Cannon for obtaining high alkalinity, and lime is the material preferred by appellant. Accordingly, the conclusion is inescapable that the use of lime in Stern to reach the desired pH of 11 or 12, or the use of a pre-gelatinized starch in Cannon would be obvious to one skilled in the art, and, therefore, such use would be non-inventive and non-patentable.

Appellant contends (Br. 2) that this case involves a distinct improvement over what was found by this Court to be unpatentable in the prior case, apparently because the claims in the prior case were to the broad idea of establishing and maintaining the pH value at about 12 without specifying any particular alkali (Br. 2), while the claims here are specific. While appellant states that the process here involved is for the use of lime to maintain the pH value at about 12 (Br. 6), it should be noted that no claim is limited to lime. The claims define a class of which lime is one member—namely, the class of alkaline earth metal oxides. Further, appellant contends that caustic soda and lime are not equivalents because, while the former will gelatinize starch, the latter will not (Br. 6); and, therefore, that, if lime were used in Cannon, the sole effect would be to increase the pH to 12.6 and there would be no gelatinization of the starch (Br. 6). And, in addition, it is urged that those skilled in the art would not use lime, because, as testified by one of the witnesses, the art thought lime was harmful to the drilling fluid (Br. 16).

On the issue of equivalency of caustic soda and lime, it is submitted that it is immaterial here whether lime will or will not gelatinize starch. This Court held in the prior case that the publication of Stern taught the art that a drilling mud containing pre-gelatinized starch at a pH of about 11 or 12 was a desirable drilling fluid. The trial Court's Finding of Fact No. 8 (A. 11) reaffirms that holding and states that the mud is brought to the necessary pH value by any desired alkalinizing material capable of so doing. The materials which can do so are known to the art and many are listed in the table reproduced from the publication "Modern pH and Chlorine Control" (A. 156). As pointed out in *Sinclair and Carroll Co.*, v. *Interchemical Corp.*, 325 U. S. 327, to select a known compound to meet known requirements from a list giving the properties thereof is not invention. It is submitted that only the skill of the art would be exhibited by the use of lime to reach the alkalinity said to be desirable by Stern, and that, since the claims sought would prevent those skilled in the art from using that material in Stern's drilling mud, the claimed subject matter is non-inventive and non-patentable.

With respect to appellant's contention that until 1945 the prior art was fearful of using lime in drilling fluids (Br. 16), it is significant that in the application involved in the prior suit, which application was filed in 1943, it is clearly stated that lime could be used instead of caustic soda (A. 137). In addition, the patent to Cannon suggested the use of lime to obtain a highly alkaline fluid, from which it may be assumed that some portion of the industry did not have the fears the witness spoke of. Under these circumstances it is thought that this contention of appellant merits little consideration on the issue of patentability.

Appellant also urges that lime acts upon a clay-laden drilling mud entirely different from the action of caustic soda (Br. 12, 13) in contending that the process claimed and its results are sufficiently distinct and outstanding to be patentable. The prime difference appears to be a lower viscosity and gel strength, and a lower water loss in the lime-treated fluid. Commercial success also appears to be urged (Br. 15). However, it should be noted that there is no suggestion of these advantages in the specification of the application at bar. In fact, the application states that caustic soda may be added to control the pH (A. 80) and there is no intimation of any real difference in the end result when lime is used in lieu of caustic soda. Where the application itself fails to disclose the advantages now urged, and where those advantages appear to have been an afterthought or at least discovered subsequent to the filing of the application, those alleged advantages have little weight in the evaluation of the contribution to the art, and in the determination of whether invention exists in that contribution. *Abbott* v. *Coe,* 71 App. D. C. 195, 109 F. 2d 449; *Aeration Process* v. *Kidde & Co.*, 170 F. 2d 437; *In re Pollock et al.* 36 CCPA 1156, 175 F. 2d 587.

Apart from the fact that appellant's commercial success with the claimed process is undoubtedly due, in part at least, to the fact that lime is less expensive than caustic soda and is easier and safer to handle (Br. 15), which are factors having little to do with the element of inventive ingenuity, it is the rule that commercial success is of importance only where the question of invention is in doubt. *Morrison* v. *Coe,* 74 App. D. C. 335, 122 F. 2d 793. Since, for the reasons hereinbefore given, the absence of invention in the present case is clear, this question of commercial success is of no significance in this case.

Accordingly, it is submitted that the finding of the Court below (Finding of Fact No. 11—A. 12) that the claimed subject matter is clearly non-inventive in view of the prior art is eminently correct and proper and should be sustained.

In addition, this Court's attention is directed to another ground of refusal which was urged below, but as to which the Court made no finding. Appellant considers the process here involved as one in which the drilling fluid containing gelatinized starch is maintained at a pH of about 12 by the addition of lime (Br. 6), whereas the fact is that no claim even mentions lime. Each and every claim sought defines the class of alkaline earth metal oxides for attaining and maintaining the pH of about 12. The application at bar defines an alkaline earth metal oxide as "the oxides or hydroxides of magnesium, barium and strontium" in addition to calcium oxide previously mentioned (A. 79). Webster's International Dictionary also includes magnesium oxide in the definition of alkaline earth metal oxide, and this Court may judicially notice that definition.

The application at bar shows that by the expression pH of about 12 appellant means the range of 11.5 to 12.5 (A. 79). The record shows that the highest pH value obtainable by the alkaline earth metal oxide, magnesia, is 10.5 (A. 156). The record also shows that appellant's expert, Farnum, conceded that a pH of about 12 could not be obtained by the use of magnesium oxide or hydroxide alone (A. 52). That means that it would not be possible to carry out the claimed process with magnesium oxide. The rule is well established that, unless every member of the claimed class is operative to achieve the result sought, the class cannot be the subject of patent monopoly. *Incandescent Lamp Patent Case*, 159 U. S. 465; *Corona Tire* v. *Dovan Chem.*, 276 U. S. 358; *American Chem. Co.* v. *Firestone Steel Co.*, 117 F. 2d 927; *Kalle et al.* v. *Multzao*, 109 F. 2d 321. Since the claims are the measure of the grant appellant seeks, and since they clearly and definitely overclaim the disclosed invention, the claims are unallowable for this reason also. While it is true that this issue was not raised by the pleadings, it became an issue because of the evidence produced during the trial, and it was urged below. Issues may be developed by the evidence. *Paine & Williams Co.* v. *Baldwin Rubber Co.*, 113 F. 2d 840; *Ind. Models Corp.* v. *Kurtz*, 93 F. S. 336. This Court is not precluded from considering any evidence of record which is relevant to and may affect the correctness of its decision. *Marconi Wireless* v. *U. S.*, 320 U. S. 1. This Court should not adjudge a party "entitled according to law to receive a patent", as required by R. S. 4915, if the facts of record show that the statute and controlling adjudications do not permit patenting in the form or manner sought. Overclaiming is a failure to point out particularly and to claim distinctly that which is asserted as invention, as required by R. S. 4888 [35 U. S. C. (1946 Ed.), 33]. Although the trial Court did not rule upon this question, it is being presented here, since the question of overclaiming is equally determinative of the ultimate question of whether appellants are entitled to a patent. It is believed that this Court, in the exercise of its appellate jurisdiction, should consider this evidence of record, in the event that the findings and conclusions of the trial Court may be considered insufficient to justify the dismissal of the complaint.

CONCLUSION

It is respectfully submitted that none of the claims sought defines inventive or patentable subject matter; that the conclusions reached by the Patent Office tribunals and the District Court as to non-patentability were proper and correct and have a rational and reasonable basis in the record; that the claims are unduly broad, and, therefore, unpatentable, because of overclaiming; and that the decision appealed from should be affirmed.

Respectfully submitted.

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JUNE 1953.

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APPELLANT'S REPLY BRIEF.

UNITED STATES COURT OF APPEALS
FOR THE DISTRICT OF COLUMBIA.

No. 11,735.

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New York, New York,
Appellant,

v.

ROBERT C. WATSON, Commissioner of Patents,
Washington, D. C.,
Appellee.

Appeal from the United States District Court
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APPELLANT'S REPLY BRIEF.

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SUMMARY OF PLAINTIFF'S REPLY TO BRIEF FOR APPELLEE.

(1) The basis of this Court's decision in the previous case cannot be determinative in this case, because the issues, causes of actions and records are different.

(2) The doctrines of res adjudicata, stare decisis and the law of the case cannot be determinative here.

(3) The application of stare decisis or the law of the case cannot result in a decision against Plaintiff in this case.

(4) The Cannon Patent and the Stern Publication do not and cannot meet the claims here involved.

(5) This case does not involve mere substitution of equivalents.

(6) The Commissioner has not offered any testimony disputing Plaintiff's testimony.

(7) Plaintiff's application in the previous case cannot constitute a statutory bar to the application here involved.

(8) An application need not disclose advantages, although the one involved here does so.

(9) The Commissioner's contention as to non-compliance of the claims with R. S. 4888, 35 U. S. C. 33, with respect to magnesium oxide has no basis in this case.

* * * * * * *

Note: In this brief, as in Appellant's Brief, the following abbreviations will again be used: App. has reference to the Joint Appendix; the transcript will be referred to as Tr., and the deposition as Dep., both noted in the margins of the Appendix. Here App. Br. has reference to Appellant's Brief and Appellee Br. has reference to Brief for Appellee. All emphasis are ours except where otherwise specified. Parts in parentheses in quotations have been supplied by us for clarity.

The Commissioner's primary opposition to the grant of the patent on the application here in suit is based upon the following grounds: **First,** that this court in the previous case, 198 F. (2d) 296, 91 App. D. C. 63, held the claims there involved, although broad enough to include the employment of an alkaline material generally, and which were based upon a particular application, answered by a Cannon patent, 2,109,858, App. 147, and a Stern Bureau of Mines Bulletin, App. 151-152. **Second,** that therefore the claims in the instant case although, in a different patent application, should be refused because they differ from the claims in the previous case only by the fact that the claims here specify a particular alkaline material, namely, lime. Such is not the case here.*

It is not clear from the Commissioner's Brief whether the opposition is based upon res adjudicata, stare decisis or the law of the case. We will simply brief the following for the convenience of this court.

Res Adjudicata, Stare Decisis, the Law of the Case.

The doctrine of res adjudicata, that is estoppel by judgment, cannot apply to this case, because this suit is **not** based upon "the same cause of action," and the question here is **not** one which "might have been presented and determined in the previous case."** This case is based upon another application not involved in the previous case. Furthermore, the claims here involved are directed to the treatment of a drilling fluid containing clay with **lime** as well as with **gelatinized** starch. The claims in the previous case simply specified **maintaining** the drilling fluid "at a pH of about 12," that is, they were directed to "the **broad idea** of establishing and maintaining a pH of 12 - - - **no particular alkali being claimed.**"†

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* The Commissioner's Counsel now, Appellee Br. p. 11, rely upon an additional defense, although admittedly not pleaded and not mentioned in the District Court's Opinion and his Findings and Conclusions. That now asserted defense will be answered, p. 28, infra.

** Blackford v. Wilder, 28 App. D. C. 535; International Cellucotton Products v. Coe, 85 F. (2d) 869, 870, 66 App. D. C. 248.

The doctrine of stare decisis may apply here, because that doctrine applies to decisions in other cases. In **Brooks v. Marbury**, 11 Wheat., p. 78, 6 L. Ed. 423, which was on a writ of error from the Circuit Court of the District of Columbia, the Supreme Court said:

> "An opinion in a particular case, founded on its **special circumstances**, is not applicable to cases under circumstances **essentially different**" (pp. 91, 426).

The doctrine of stare decisis is "not a doctrine of mortmain."* Adjudications of similar questions are persuasive or controlling only so far as they are based upon analogous facts.**

The doctrine of "the law of the case" is generally applied to **the same case** on remand and by the higher court on a second appeal in the same case. Even there the court considers **upon what grounds** the judgment was entered and **what was presented and decided.**

In **Thompson v. Maxwell R. Co.**, 168 U. S. 451, 18 Sup. Ct. 121, the Supreme Court said, p. 123:

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† Board of Appeals decision in this case, App. 128. One of the claims in the previous case reads as follows:

> "Claim 3. In the art of drilling wells by the employment of an aqueous mud-laden drilling fluid, the process comprising, adding to such a fluid, while maintained at a pH of about 12, sufficient of a starchy colloid to attain and maintain a substantial wall-seal of low water loss, viz., below 5 cc (A. P. I.) and at an operable well-drilling viscosity." Appeal 10,873, App. p. 212.

Actually, no alkali is mentioned in the claims.

* McKenna v. Austin, 134 F. (2d) 659, 664, 77 App. D. C. 228, decision by the later Associate Justice Rutledge, with whom sat the later Chief Justice Vinson.

** C. F. Medaris Co. v. Commissioner of Internal Revenue, 38 F. (2d) 812-813, C. C. A. 6.

> "We take judicial notice of our own opinions, and, although the judgment and the mandate express the decision of the court, yet we may properly examine the opinion in order to determine **what matters were considered, upon what grounds** the judgment was entered, and what has become settled for future disposition of the case. We therefore turn to the former opinion and the mandate to see **what was presented and decided.**"

Luminous Unit Co. v. Freeman-Sweet Co., 3 F. (2d) 557-580, C. C. A. 7, states the rule as follows:

> "The rule of the 'law of the case' differs, to a certain extent, both in the **reasons back of** it and in its conclusiveness, from the rule of res adjudicata, and also from the doctrine of stare decisis. As to its conclusiveness, it lies somewhere between the two. - - - It is, however, **not an inexorable rule,** and should not be applied where the law as announced is clearly erroneous, and establishes a practice which is contrary **to the best interests of society,** and **works a manifest injustice in the particular case.**"

The Court of Appeals, in such a case, will not reconsider any questions either of law or fact which were considered and determined on the first appeal, **provided** the **testimony** on the first trial was **substantially the same.**† If, however, on the second appeal, the evidence is **substantially different** in material respects from that presented on the former appeal, the rule of "the law of the case" should not be applied.* The Court of Appeals is unwilling to be bound by the **general expressions** in the former opinion; an Appellate Court ought to have power to do justice according to law and "justice is better than consistency."** The rule is **not** an **unyielding** one which takes from the Court of Appeals the power to correct manifest error or plain mistake of a serious nature in a hearing in the previous decision.***

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† **Balch v. Haas,** 73 F. 975-976, C. C. A. 8.

* **U. S. v. Pullig,** 63 F. (2d) 379, C. C. A. 8.

** **Seagraves v. Wallace,** 69 F. (2d) 163, 164, 165, C. C. A. 5.

The Basis of This Court's Decision in the Previous Case Cannot Be Determinative in This Case.

We do not, in this case, ask this Court, nor did we in Appellant's Brief, ask this Court, to revise its opinion and judgment in the previous case. We say that this case is one, on **a particular application,** with **particular claims,** and therefore involves a different **cause of action** with different issues than in the previous case; and this case is based upon **a different record** applicable to the claims here involved, as distinguished from those involved in the previous case. Here we ask this Court not to extend the disclosure of the Cannon patent as the Commissioner's Counsel ask this Court to do, namely; not only to substitute starch for quebracho, but to make **a second substitution** of lime for caustic soda. The evidence shows that such a second substitution will not only fail to gelatinize the starch, but the lime will flocculate and the entire drilling fluid will become worthless, App. Br., 8, 16.

The **Cannon** patent must be considered **in its true light** when applied to this case. The only examples given of drilling fluids, App. 148 right, are those of caustic soda, quebracho (crude tannic acid) and bentonite (a highly colloidal clay, App. 19, Tr. 31). The functions of the bentonite and of the caustic soda and quebracho are stated by Cannon, as follows, App. 148 right, lines 71, etc.:

> ''Sufficient bentonite is present in the drilling mud to render the mud excessively plastic, except that **its**

*** State of Kansas ex rel. Beck v. Occidental Life Ins. Co., 95 F. (2d) 935, 936, C. C. A. 10.

> **plasticity is reduced** (thinned) by the addition of the tannic acid or the like plus alkali in such amounts that the resulting drilling fluid does not attack the heaving shale.''

It is clear from the above that Cannon's function of the caustic soda and quebracho (they are used together) was **to thin and not to thicken** the bentonite clay, and such has been their combined function from 1930 on, Farnham, App. 19, Tr. 32. On the other hand, **gelatinized starch** acts to **increase** the plasticity, that is, **thickens** the drilling fluid, while ungelatinized starch will not gel and is of no value in a well, App. 23-24, Tr. 39.

The Cannon patent, however, also mentions ''starch,'' App. 148, left, line 4 (not gelatinized starch); but this Court said, 198 F. (2d) 298:

> ''The **Cannon** patent relates to a drilling fluid (for shale) which includes **a starch** and **caustic soda.** A 1% solution of the latter will hydrolyze or gelatinize the starch''; further that ''the pH value of a 1% solution of caustic soda is just under 13.0''; further that **Stern** disclosed gelatinization of starch by caustic soda and attained ''a pH of about 11.0 and 12.0.'' This court, therefore, found in Cannon and Stern nothing ''missing which Appellants supplied,'' **as a matter of procedure**, because Cannon and Stern disclosed, as finally produced, a drilling fluid containing gelatinized starch at a pH of about 12, which is all that the claims in that previous suit specified. In answer to Appellant's contention in that case, that ''it was unknown that gelatinized starch could be prevented from deteriorating in a drilling fluid by maintaining the alkalinity of the latter at about 12.0,'' this court said that ''was at least indicated by prior disclosures'' and that ''increase in knowledge of its properties did not call for the grant of a patent.''

While this court did not use the exact language that the subject-matter in the previous case was disclosed by Cannon and Stern, because **inherent** in their disclosures, we believe that that was a basis of this court's decision. The fact is, however, that this court found that both Cannon and Stern employed caustic soda not only to gelatinize the starch, but to attain a pH of about 12.

The **Cannon** patent, however, also mentions "lime," App. 147 right, line 54. Let us see what will happen if after **a first** substitution of starch for quebracho for use with caustic soda, **a second** substitution of lime for caustic soda be resorted to. Here there is **no possibility of inherency,** but actually the opposite is true, namely: that by such double substitution, the drilling fluid involved here **will not be produced,** but on the other hand, something which is worthless as a drilling fluid, and which the art sought to avoid from 1932 to 1945, when in the latter year the process here involved was first practically used in two wells; App. Br. 8, 16, 17.

> **We have shown in this case, by evidence which has not been contradicted by the Commissioner,** that when lime is substituted for caustic soda in either the Cannon or Stern processes, then in neither case will the starch become gelatinized so that the drilling fluid will be worthless. Further that the mere attainment of a pH of 12 by lime will not convert something having no utility into something having utility. There is accordingly **nothing inherent** in the Cannon and Stern disclosures which will produce what is here claimed.

Forward Process Co. v. Coe, 73 App. D. C. 100, 116 F. (2d) 946, was a decision of this court involving the question of whether **inherently** the application in that suit disclosed a certain thing. In holding otherwise, this court said, p. 947:

> "Appellant contends that 'a person following the process described in the Forward patent will usually

> obtain the conditions called for by the claim.' We think **it is not clear that such a person will ever obtain those conditions.** The case is therefore far from meeting the requirements of the doctrine of inherency. **'Inherency** * * * may not be established by probabilities or possibilities. The mere fact that a certain thing may result from a given set of circumstances is not sufficient.' "

In **Switzer v. Marzall**, 96 F. Supp. 332, Judge Keech said, p. 333:

> " '* * * Inferences as distinguished from disclosures, especially when drawn in the light of after events, cannot be accepted as a basis of anticipation.' "

It is entirely clear that in this case, the **Cannon** patent **simply cannot ever attain** a condition where the starch will be gelatinized by caustic soda, but the starch will be left inert with the lime flocculating the clay drilling fluid, so as to produce a useless thing. In patent law, like in common sense, a thing that will not work cannot be the same as something that will work.

Lombard v. Coe, 33 F. Supp. 440, D. C. D. C., is somewhat analogous. The case involved a process for making an abrasive article by uniting diamond particles by a ceramic bond. A prior Poulain process specified a temperature of 1250° C.; that, however, Judge Luhring found was "destructive of the diamond particles." A prior Benner process was to the same effect. Neither were held to disclose the plaintiff's process. Here lime simply will not gelatinize starch, but the lime is left to flocculate the clay.

The Cannon Patent and the Stern Publication Do Not and Cannot Meet the Claims Here Involved.

The question then is, can the reasoning of this court in the previous case be applied to this case, to meet the claims here involved, viz., claim 12, App. p. 86:

> **12.** "In the art of drilling wells through formations by the employment of an aqueous **mud-laden** (clay) well-drilling fluid containing **an amylaceous emulsoid colloid** (gelatinized starch) which is subject to deterioration during the course of drilling, the process, comprising, maintaining such a drilling fluid, during the course of drilling, at a pH of about 12 by addition thereto of **an alkaline-earth metal oxide** (lime) in order to inhibit such deterioration, and maintaining the drilling fluid during the course of drilling, at a water loss of about 5 cc by addition thereto of the **amylaceous-emulsoid-colloid**" (gelatinized starch).

The answer is, that cannot be for the following reasons: In **Cannon,** when lime is substituted for caustic soda, the starch will not become gelatinized. That is also true of **Stern,** although he only specifies caustic soda for the very purpose of gelatinizing the starch, but mentions a pH of 11 or 12, which can only be by caustic soda.

The Commissioner's Counsel have not denied the following assertion in Appellant's Brief, supported by evidence; nor did the Commissioner at the trial controvert that evidence. Those statements based **upon evidence** are as follows:

> (a) That while caustic soda will gelatinize starch, lime will not even at a pH of 12.6, nor at any temperature, but that the presence of lime will prevent gelatinization of the starch, App. Br. p. 6.
>
> (b) That in Cannon, even with a substitution of starch for quebracho, upon an attempted **second substitution** of lime for caustic soda **inherently** the starch will **not** become gelatinized, so that all that will happen is that the fluid will be brought to a pH of 12, but with the starch left ungelatinized and therefore of no value in a well, App. Br. p. 7.
>
> (c) **That lime** has been considered as in the nature of a poison in the drilling art, to be avoided and

neutralized, because lime **will flocculate** the clay necessarily used in a drilling fluid, and that such has been the view of the art from at least 1932 to 1945, App. Br., pp. 8, 16, 17.

(d) **It is only when lime is used in connection with gelatinized starch,** that the objections to the use of lime are not only overcome, but then lime with gelatinized starch is made to do **useful work** in producing a radically new drilling fluid, App. Br., p. 8.

(e) That **until 1945** the drilling art was still fearful of using lime in drilling fluids because they thought it would ruin it, and it was not until that year that Plaintiff was able to persuade drillers to use lime with gelatinized starch, App. Br., pp. 16-17.

(f) That the drilling fluid produced by the process described in the specification of the application in suit is **a radically new drilling fluid,** in which there is **an entirely different action,** involving a **different principle** of operation, with even the **resultant clay different** than where caustic soda is used, because lime alters the nature of the clay, which is however **protected** by the gelatinized starch, App. Br., pp. 11-12, 14-15.

(g) That the viscosity and gel characteristics of a lime-gelatinized starch drilling fluid are of **an entirely different order** than those of a caustic soda-gelatinized starch drilling fluid, gives a more favorable water loss, and is easier to control and is more economical, App. Br., pp. 13-14.

(h) That the lime-gelatinized starch system has an advantage in cost over the caustic soda-gelatinized starch system, **not simply** in the relative cost of lime and caustic soda, but because more clay solids can be included, before a necessity for dilution and building up its weight again, App. Br., pp. 12-14.

(i) That the lime-gelatinized starch system has replaced the caustic soda-gelatinized starch system on the basis of 4 to 1, App. Br., p. 15.

The Application of Stare Decisis or the Law of the Case Cannot Result in a Decision Against Plaintiff in This Case.

It will be seen from the above that, whether we apply to this case the doctrine of stare decisis, or the doctrine of the law of the case, the grounds of the judgment in the preceding case and what was presented and decided there, cannot form a basis of a decision against Plaintiff here in this case. The circumstances here are special and entirely different than in the previous case. This case is not even based upon nonanalogous facts but upon testimony which is entirely different than in the preceding case, and necessarily so. The cases are certainly not analogous; for while in the previous case caustic soda and starch did inherently result in gelatinized starch at a pH of 12, such cannot be the case here, because lime will not gelatinize starch and the only thing that will happen will be that lime will be left to flocculate the clay.

The rule of the law of the case is not so inflexible or inexorable by its too strict application so as to work a manifest injustice to the applicant here, contrary to the best interests of society, which has as its object to encourage invention and patent protection therefor as a reward.

The Commissioner's Counsel cannot use this court's decision in the previous case as a basis of refusal of the application here involved. The matter there considered and presented, was a Cannon patent. The ground on which the judgment was rendered in that case and the reason back of that judgment was that **inherently** the Cannon process, when using caustic soda would **inevitably** produce gelatinized starch with the drilling fluid at a pH of about

12. Here, the proposed second substitution of lime for caustic soda in the Cannon process will simply not do that, but will only produce something which is useless. The Commissioner's Counsel cannot therefore start from scratch with what this court decided was not patentable, but must again start with the Cannon patent and the Stern publication, neither of which discloses the process here involved.

The Commissioner's Counsel cannot base his contention for refusal of the patent in this case on the fact that here the difference is merely in the substitution of lime for caustic soda. Counsel have just slipped a cog, because the substitution of lime for caustic soda in the process of either Cannon or Stern, will not produce a drilling fluid containing gelatinized starch, but one containing inert starch, with the lime flocculating the clay, for the latter is not protected by gelatinized starch as in the process here involved.

This Case Does Not Involve a Mere Substitution of Equivalents.

This case is not one of mere substitution of equivalents, that is lime for caustic soda, because of the fact that in a narrow sense, both will attain a pH of 12. The question is **how** do they work in the **particular environment** in this case, that is in a drilling fluid **containing gelatinized starch and clay.** As to starch, caustic soda will gelatinize starch, lime will not. As to clay, caustic soda will act entirely differently even when gelatinized starch is used, App. Br. 11-13. The Supreme Court said years ago, as to equivalents, in **Machine Co. v. Murphy**, 97 U. S. 120, 125:

> "Except where form is of the essence of the invention, it has but little weight in the decision of such an issue, the correct rule being that, in determining the question of infringement (or validity), the court or jury, as the case may be, are not to judge about simi-

> larities or differences by the names of things, but are to look at the machines or their several devices or elements **in the light of what they do,** or **what office or function they perform,** and **how they perform** it, and to find that one thing is substantially the same as another, if it **performs substantially the same function in substantially the same way to obtain the same result,** always bearing in mind that devices in a patented machine are **different** in the sense of the patent law when they perform **different** functions or in a different way, or produce a substantially different result."*

Robinson on Patents likewise stated years ago, Vol. 1, Sec. 248, pp. 337-338:

> "The first essential attribute of an equivalent is its capability of serving as a substitute for the act or substance in whose place it is employed. The existence of this capability **cannot** be ascertained by an examination of the alleged equivalent **alone,** nor by **comparing** the two acts or substances in their **separated** state. It depends entirely upon the relation which each occupies **toward the invention** into which they enter, and on the manner in which each co-operates in the invention with **the other acts or substances** to which it is there united. Equivalence can therefore be determined only by contrasting the two acts or substances **when associated with the other elements** of the invention, and engaged in the performance of the functions which they are intended to dischage."**

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* That view was affirmed in the **Sanitary Refrigerator** Co. v. Winters, 280 U. S. 30, 42.

** **Ward Baking Co. v. Hazleton Baking Co.,** 292 F. 202, D. C. Pa., involved a patent for the employment of potassium bromate in making bread. Defendant contended that potassium bromate belongs to a class of chemical substances known as oxidizers, which had been used in bread making, p. 204, but the evidence showed that potassium bromate **acted differently in bread making** than did the other oxidizers. Judge Witmer said, p. 205:

> "An equivalent has been defined as a thing which works in substantially the same way to accomplish the same results, and perform the

Farnham was asked and answered as follows, App. 45-46, Tr. 72-73:

> Q. "In a drilling rig the caustic soda and lime, whether calcium oxide or calcium hydroxide, performs the same function in substantially the same way, secures substantially the same results?
>
> **The Witness:** No, the **only point** of likeness between the two is that they both contribute to the **alkalinity. The great point of difference between the two is their effect when they combine with the clay mineral in the drilling fluid.** In the one case the sodium hydroxide or caustic soda virtually combines with the clay mineral and it swells, a combination with considerable water. In the other case, when calcium hydroxide is used, the calcium replaces the sodium on the surface of the clay mineral and virtually denatures it. In that case it cannot swell with water, and thereby does not contribute to the viscosity of the drilling fluid, but rather contains it in like fashion as does the sodium type of clay."

Corona Co. v. Dovan Corp., 276 U. S. 358, involved a process of treating rubber with **a particular vulcanizing accelerator**, namely, diphenylguanidine. The use of triphenylguanidine as an accelerator was known, p. 368, and the two were closely related chemically. The late Chief Justice Taft said, pp. 368-369:

> "So closely do the chemical compositions of these two resemble each other that the petitioner contends that the patent is invalid because the utility of D. P. G.

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same functions as the thing for which it is substituted. It cannot be said from the comparison observed between the uses made of the oxidizing persulphates and bromate that the effects produced are the same as applied to the same subject-matter and thus constitute chemical equivalents. And for the same distinguishing results in the comparisons made between the uses, if the chemicals mentioned should be regarded as substitutions, there being new properties and results developed in the art of bread making, it cannot be said that such results would have been obvious to those skilled in the art of bread making."

> **as an accelerator** was plainly indicated by general chemical knowledge and did not involve patentable discovery after T. P. G. had proven to be a good one for this purpose. But we can not agree with this view. The catalytic action of **an accelerator** can not be forecast by its chemical composition, for such action is not understood and is not known except by actual test.''*

Gasoline Products Co. v. Coe, 66 App. D. C. 333, 87 F. (2d) 550, involved the substitution of an iron chromium alloy for steel **in an oil-cracking still.** This court, after referring to the substitution of ''superior for inferior materials'' said, pp. 519-520:

> '' 'It is also the law, as exceptions to this general rule, that if the substitution involved **a new mode** of construction; or if it developed **new properties** and uses of the article made; or where it **produces a new mode of operation,** or results in **a new function;** or when it is the first practical success in the art in which the substitution is made; or where the practice shows its superiority to consist not only in greater cheapness and greater utility, but also in **more efficient action,** it may amount to invention.' ''

Mathieson Alkali Works, Inc., v. Coe, 69 App. D. C. 210, 99 F. (2d) 443, involved a process of bleaching cellulosic materials with a **chlorite** as distinguished from a **hypochlorite.** This court, in considering the position taken by the Patent Office and by the District Court said:

> ''They took the position that disclosures in these references, whether known or unknown by the applicants, were sufficient to inform them that the prior art taught the use of chlorites for bleaching purposes. Appellant, on the other hand, contends that while

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* The Weiss patent was later held invalid over a prior use by one Kratz, p. 385.

> hypochlorites were used by the industry for bleaching purposes, chlorites were not so used; that the discovery of their practicability for this purpose resulted from experiments which **flew directly in the face of the teaching of the prior art;**"*

In this case, we must **not simply** consider the fact that lime, like caustic soda will raise the pH of **water,** but must consider **what they do** when used in a drilling fluid containing **clay** and **gelatinized starch.** That **they act entirely differently upon the clay component** of a drilling fluid was shown by Plaintiff's witness, Farnham, whose testimony was quoted, App. Br. 11-15. That action was also set out in the specification of the application in this suit quoted from App. Br. 10-11. Actually, when lime is used, the **gelatinized starch itself acts differently** than when caustic soda is used, because lime will not interfere with the dispersion of the clay into fine particles, so as to not interfere with low fluidity, but will actually combine with the clay particles to form a water-seal of low water loss. Neither Farnham's testimony, nor the specification statement was disputed by the Examiner, nor by the Board of Appeals, nor by cross-examination, nor by any evidence offered by the Commissioner, nor by the Commissioner's Brief.

We do not contend that a caustic soda-gelatinized starch process is not useful. We frankly showed by Farnham on direct examination,** that it is useful; that it was in use in 1942 and is still in use, however, only to the extent of **20%** of the total, but with the lime-gelatinized starch process topping it to the extent of **80%** of the total. The lime-gelatinized starch process is **not only superior** to the lime caustic soda process but it **differs in fundamentals,** viz., in action, principle, viscosity and gel-characteristics, ease of control, cheapness and safety to life and limb and all at a more favorable water loss, App. Br. 10-17. Farnham testified, App. 48-49, Tr. 76-77:

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* That the latter is true here appears from the testimony in this case summarized, App. Br. 8 and 16-17, not disputed by the Commissioner in this case.

** App. 24, Tr. 30; App. 32, Tr. 52; App. 33, Tr. 53.

> "**Q.** In your opinion—and I know you are employed by the Baroid Sales Division of National Lead Company—can you tell me whether or not this lime-starch system was or was not a substantial contribution to the drilling art? **A.** I saw this after 1945, and we induced several people to use lime in place of caustic soda in the high pH system. Those that went to it stayed with it, so that we replaced fully eight wells out of ten in the high pH system, replacing caustic soda with lime, and the end result was a substantial saving to the drilling company. That replacement material was required to maintain the mud in the condition that they desired it during subsequent drilling."

None of the above testimony was disputed by the Examiner, nor by the Board of Appeals, nor by the Commissioner's Counsel in their brief.

The Commissioner Has Not Offered Any Testimony Disputing Plaintiff's Testimony.

We realize that the Commissioner's Counsel, in R. S. 4915 cases relies upon the record made in the Patent Office by the Examiner and by the Board of Appeals and upon what they said, and that the Commissioner does not generally call witnesses to controvert Plaintiff's testimony.*

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* **Switzer v. Marzall**, 96 F. Supp. 332, 333, D. C. D. C., however, shows that the Commissioner did offer testimony in the form of an affidavit in an attempt to reopen a case. In **Larsen v. Kingsland**, 77 USPQ 214, D. C. D. C., conducted by Mr. Miller in behalf of the Commissioner, and by Plaintiff's Counsel here as Counsel for Larsen, Mr. Schimmel, now of Counsel for the Commissioner, actually took the witness stand as a former assistant Examiner in the art there involved and testified as to an alleged equivalence of something in a prior publication as related to Larsen's invention. The judgment was for Plaintiff in the Larsen case.

There is no reason, however, why in a proceeding under R. S. 4915, a District Court should not draw an inference from a failure of a Defendant to produce testimony to controvert Plaintiff's testimony; **Teapot Dome Case, 275 U. S. 13, 52.**** In **Turchan v. Marzall**, 105 F. Supp. 266, Judge Tamm did so stating p. 271:

> "In the absence of any showing on the part of the defendant that there is some other type tracer that would operate in the plaintiffs' patent, the Court would have to hold that the plaintiffs have sustained their burden of proof in this case."

In **Pattinson v. Marzall**, 100 F. Supp. 787, Judge Holtzoff commented, pp. 788-789, upon the different positions taken by the primary Examiner and the Board of Appeals in refusing a patent, like as we showed here, App. Br. 7-8. Judge Holtzoff said:

> "There is a **presumption** in favor of the findings of the Patent Office on questions of fact. - - - It is not sufficient to render **lip-service** to this presumption. It is a presumption that **must be actually applied**, and must be in the mind of the court in passing on cases such as this." (p. 788)
>
> "The court is of the opinion that the **uncontradicted** evidence has established important advantages to be derived from the use of salt cavities, as distinguished from porous rock." (p. 789)

We have shown above in enumerating points, (a)-(i), p. 9 supra, that the Commissioner's Counsel have not denied the fundamentals involved in this case and, of course, no testimony was offered by them at all.

** "Familiar rules govern the consideration of the evidence. As said by Lord Mansfield in Blatch v. Archer (Cowper 63, 65):

"'It is certainly a maxim that all evidence is to be weighed according to the proof which it was in the power of one side to have produced, and in the power of the other to have contradicted.'"

This is not a case where the Commissioner's Counsel, for the first time was faced at the trial with testimony of witnesses, namely; that when **a second substitution** of lime for caustic soda in the Cannon Patent be resorted to, the starch would not become gelatinized. By an affidavit of Offeman, filed June 2, 1950, App. 94, etc., Offeman detailed a test showing that while caustic soda will gelatinize starch, lime would not but settled out even at a pH of 12.4, and he concluded as follows, App. 96:

> "I conclude, therefore, that calcium hydroxide is not a gelatinizing agent for cornstarch."

In the Examiner's statement of July 13, 1949, App. 122, that was not denied, but he simply stated, as to the Cannon patent, App., p. 124:

> "It is the Examiner's position that the amount of lime used would inherently bring the mud to a pH of about 12."

That obviously does not answer the question here involved. In the Examiner's Reply to Appellant's Brief, App. 125, the Examiner again does not question Offeman's affidavit, but he simply said, App. p. 126:

> "The affidavit merely shows the differences in the action between caustic soda and lime in a drilling mud containing starch which is not the point in issue. The patent to Cannon discloses both CaO and starch in drilling muds and the Examiner has not questioned the equivalency of sodium hydroxide and lime."

Again that again does not answer the question. In the decision of the Board of Appeals, App. 126, the Board asserts, p. 130:

> "that alkalies will gelatinize starch without the addition of heat seems to be accepted as a fact. See, for example, Radley, pages 264 and 265, which states that starch will undergo gelatinization with alkalies at

> room temperatures. Appellants present no proof to the contrary."*

As to the last sentence, we had submitted to the Patent Office the affidavit of Offeman not disputed by either the Examiner in his Statement, nor in his Reply but only by the Board of Appeals because of a Radley book. As to Radley in Appellant's Brief, **we challenged** the Commissioner's Counsel as follows, p. 29:

> "The Board of Appeals then switched to Radley's publication, DX 1, and argues, App. 130, 'that starch will undergo gelatinization with **alkalies** at room temperature.' We want to note, however, that the Board did not make any quotation from Radley's book. **We therefore challenge** the Commissioner's counsel to show where Radley has reference to lime, calcium oxide, calcium hydroxide or any other alkaline-earth oxide or hydroxide. We find none. The only reference to any alkali is 'caustic soda' recited three times in Radley's book, page 265." (App. 155)

We find no reply to our challenge, nor even a comment with respect thereto in Appellee's Brief.

It is apparent that in view of the above situation, the Commissioner's Counsel should have known what evidence would be offered at the trial and should have been ready to offer evidence controverting what the Commissioner's Counsel must have known we would offer. Nothing of the kind was done. Offeman's affidavit was received in evidence as were the Examiner's Statement and Reply and the Board of Appeals Decision. Farnham and Larsen then supported the Offeman affidavit by testimony, and they were subjected to cross-examination. Their testimony is summarized and partly quoted from, App. Br. 6-7.

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* As to what precedes the above, the statement, App. 129: "There is every reason to believe that the starch in Cannon is gelatinized due to the action of the lime, particularly if heat be present at the bottom of the well"; we showed, App. 7-8, that that simply will not happen, citing Farnham's testimony, which was not contradicted by any evidence, nor denied by the Commissioner's Counsel in their brief.

Farnham indeed went further and carried out tests before the court, summarized App. Br. 13-14, comparing the lime-gelatinized starch treatment with the caustic soda-gelatinized treatment and showing the outstanding distinctions between the two. Again there was no testimony offered to dispute Farnham; in fact, the reliability of his tests was not even denied in the Commissioner's Brief.

In the original application as filed, the specification of the application in suit described the outstanding distinctive characteristics of the lime-gelatinized starch drilling fluid which is quoted App. Br. 10-11. Neither the Examiner nor the Board of Appeals disputed that, and neither do the Commissioner's Counsel do so in their brief.

We went, however, further and had Mr. Farnham, one highly skilled in this art, support the specification and the outstanding characteristics of a lime-gelatinized drilling fluid as distinguished from a caustic soda-gelatinized starch drilling fluid, and his testimony is summarized and partly quoted from, App. Br. 11-17. None of Farnham's testimony was disputed at the trial, nor do the Commissioner's Counsel dispute that testimony in their brief.

In short, all in the world that the Examiner, the Board of Appeals and even the Commissioner's Counsel in their brief can say is that lime will bring a drilling fluid to a pH of about 12 and that this Court should, therefore, hold that all that Plaintiff's Applicants have done is to substitute lime for caustic soda in the Cannon patent and in the Stern publication. **They simply close their eyes** to the fact that when that is done the **starch will not become gelatinized**, but what is left is **inert starch** with the **lime left to flocculate the clay** of the drilling fluid, which is the very thing that the entire drilling art feared from 1932 on, App. Br. 8, 16, 17.

This is **not** a case involving **mere selection** of an alkaline agent as contended, Appellee Brief pp. 5, 7, 8. **Sinclair v. Interchemical,** 325 U. S. 327, involved a simple selection and substitution of one solvent for another solvent having the same properties with simply superior results, p. 381. Here the record shows that substitution of lime for caustic soda simply will not work but will produce something useless; App. Br. pp. 6-8.

This case is not one where lime is simply less expensive or less corrosive than is caustic soda, Appellee Brief p. 6, 10; that is simply an advantage which we submitted to the Court and which has not been disputed. This case is one where **an entirely new drilling fluid** has been produced; Pl. Br. 10-17.

The Commissioner's Counsel having failed to produce any evidence that the drilling art was fearful of the use of lime from 1932 to 1945, content themselves with the statement in their brief, p. 5, that Cannon's suggested use of lime "is indicative of the fact that some of those skilled in the art did not believe that the use of lime was to be feared." Why did not the Examiner or the Commissioner's Counsel call a single witness or offer a single publication of one skilled in the art that Plaintiff's evidence was wrong? Why did Stern of the Bureau of Mines, in his bulletin, DX 1B, in 1941, App. 151-152, simply refer to Cannon and then state:

> "It is **only recently** that starch has found application in drilling muds as a result of the development that hydrolyzed starch imparts a good filter test to salt-water mud. For this purpose the starch may be hydrolyzed by boiling a 10-percent starch suspension in sodium hydroxide. A pH of about 11 or 12 has been found desirable."

Why did Jones of Union Oil Company, as late as 1941, seek to neutralize lime with sodium carbonate?* Why did Chaney of Sun Oil Company, PX 3-A, App. 160, in 1942, warn against lime as a poison to be avoided in a drilling fluid and prescribe neutralization with various chemicals, p. 163? The trouble with the Commissioner's Counsel, in a proceeding under R. S. 4915, is that they **seek to substitute guesses and argument for evidence.**

Plaintiff's Application in the Previous Case Cannot Constitute a Statutory Bar in This Case.

Plaintiff's application involved in the previous suit cannot be made a statutory bar under R. S. 4886, 35 U. S. C. 31, as the Commissioner's Counsel suggest in their brief, pp. 5, 7. R. S. 4886 establishes as a bar something "known or used **by others,**" not something known or used by the applicants themselves.** Here no patent has issued on the application involved in the previous suit.

Ethyl Gasoline Corp. v. Coe, 78 App. D. C. 233, 139 F. (2d) 372, is somewhat analogous. The Commissioner had suggested for interference a claim from another application to Ethyl's applicant, which Ethyl refused to copy into its application. The Patent Office then rejected Ethyl's claims on the claims suggested as not patentable thereover. This Court in sustaining Plaintiff said, p. 373:

> "This, we think, goes too far. Whatever may be the effect of the rules adopted by the Patent Office, whatever may be the merits of the present claims, it is obvious that 'the prior art' cannot include facts un-

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* During the trial, App. 29-30, Tr. 48, we cited **In re Jones,** 120 F. (2d) 1018, C. C. P. A., and in Appellant's Brief, p. 16, footnote, as showing that as late as that decision, June 30, 1941, lime (in cement) was eliminated by sodium carbonate, although previously disclosed by Petroleum of 1932.

** Actually a second application will be given the date of a prior pending application as to subject-matter common to the two. **Ex parte Replogle,** 25 U. S. P. Q. 121, Board of Appeals.

> known to the prior art before the application was filed.''

Radtke Corp. v. Coe, 74 App. D. C. 251, 122 F. (2d) 737, shows a reverse situation. Reliance was had upon priority to plaintiff's applicant, Vogt, in another proceeding. This Court said, p. 940:

> ''As the patent therein authorized to be issued to Vogt has never been issued, and as the present suit arises again under R. S. § 4915, the question of patentability, thus presented to us for the first time, is the question of primary importance.''

From the above it is apparent that a claim in an application in suit may not be refused because the subject-matter was disclosed in a copending application by the same applicant. Further, that in a suit under R. S. 4915, this Court will consider the case before it and not something hypothetical. That is exactly what the Patent Office attempts to have this Court do in this case. Actually the Patent Office has refused the claim in this application because not patentably distinguished from some thing disclosed in a Cannon patent and a Stern publication, even though neither of them will work if lime be substituted for caustic soda.

The Commissioner's Counsel, in their brief, p. 5, assert that the application involved in the previous suit ''disclosed that lime could be used and did not indicate that it was detrimental.'' Counsel, however, failed to state what that original application actually stated, namely: **it did not recommend the use of lime by itself** in the drilling fluid, but **only in connection with gelatinized starch.** That original application not only actually refers to flocculation by lime, but the complete expression is, App. 137:

> ''However, even lime ($Ca(OH)_2$) may be employed, particularly as soda lime, although lime is not as effec-

> tive as caustic soda[**] and its tendency is one moreover to **flocculate** the drilling fluid **before starch is added.**"

Farnham, after having the above quoted to him, testified, App. 27, Tr. 45:

> "**Q.** Suppose you bring a drilling fluid to the pH of 12.6 or 12.4 with lime, you begin to flocculate the clay? Is that right? **A.** Yes, it will. **Q.** Suppose you then **add starch?** **A.** Then you will reduce the viscosities and gel strengths that have been caused by flocculation of the clay, and **greatly reduce the water loss that has been increased through the addition of calcium hydroxide.**"

The above clarifies the situation and was not disputed by the Commissioner's Counsel. It was not necessary to add to the original application specific claims for the employment of lime where that original application was directed to broad subject-matter:

> "We are not aware of any rule of law that compels an applicant to put all of his specific claims in the parent patent containing the generic claims." **Ex parte Jeffrey et al.**, 60 U. S. P. Q. 424, Board of Appeals.

The Commissioner's Counsel assert in their brief, pp. 5 and 7, that the original application disclosed lime and caustic soda as equivalents.[*] The contrary is true, as appears from what has just been said and at p. 25, supra. Indeed that could not be so, for a lime-gelatinized starch system has replaced the caustic soda starch system on a ratio of **4 to 1**, App. Br. 15, which is not denied. This is the case so frequently encountered in patent practice, where **a particular embodiment** finally turns out to be outstanding; and in this case, Plaintiff could not persuade the drilling art to even try out the lime-gelatinized starch process until 1945, App. Br. 16 and 17. Plaintiff is not in the business of drilling wells, but sells material for such purpose on which, however, licenses are offered to the drilling art on a royalty basis with no restrictions, App. 16, Tr. 34-35. This is the usual case of things **generic** and things **specific**, which was so well discussed by Judge Denison in **Curry v. Union Co.**, 230 F. 422, C. C. A. 6, p. 429:

[**] Farnham showed, App. 40, Tr. 64, that actually, based on his present experience, lime is more effective to secure a low water loss, as well as having the manifold advantages shown, App. Br. pp. 10-17.

[*] Claims cannot even be rejected on an applicant's own showing of equivalency, Ex parte Fein, 81 U. S. P. Q. 73.

> "It is a natural thought that if device **b** is the mechanical equivalent of patented device **a** and so infringes, then, because it is the equivalent of what is old in the art, it cannot be patentable, and the finding that it is patentable implies that it is not an equivalent; but this also fails to observe the **relative** rather than the **absolute** meaning of equivalency. Its existence depends on its range or scope, and device **b** may be the equivalent of **a**, when the latter is broadly considered, and yet **a** not be the equivalent of **b**, when the latter is defined as narrowly as it must be."

The original application was simply based upon broad claims as the Board of Appeals specifically found, App. Br. 3, and is also apparent from the claim quoted p. 3, supra, footnote. It certainly would be an injustice to Plaintiff here to apply any "law in the case" where an injustice will result.

An Application Need Not Disclose Advantages, Although the One Here Involved Does So.

The Commissioner's Counsel assert, pp. 5, 10, that the application in suit does not disclose **the advantages** of the process here involved. **First,** that is not necessary:

> "If employment of D. P. G. as a useful accelerator was a discovery by Weiss, prior to anyone else, Weiss, or his assignee, is **entitled to all the advantages** that flow from that increased activity or from any other quality in its use as such." **Corona v. Dovan,** 276 U. S. 358, 369.

Second, the application in suit, quoted App. Br. 10-11, contains a complete, although brief, explanation of the new drilling fluid obtained by the process here involved and its various advantages. In view of the above, the decisions cited Appellee Br. 10, cannot apply.*

The Claims Here Involved.

As to the claims here involved, the Commissioner's Counsel's observations, Appellee Br. pp. 3-4, are incomplete and even erroneous. Claim 12 quoted p. 9 supra, is a complete claim which we relied upon before the District Court as representative, and in which we primarily rely upon here. Counsel are wrong when they say "only claim 11 specifies that the pH is maintained during the course of drilling by the addition of alkaline metal oxide". A reference to claim 12 shows that Counsel are wrong. Counsel further say, "all other claims recite that such compound is used to bring the composition up to the pH of 12, but are silent as to what material is used to maintain that pH during the course of drilling." Counsel are certainly wrong as to claim 12, and as to claims other than claims 11 and 12, it is fundamental that reference must be had to the specification.* The general statement, quoted App. Br. 9-10, specifically says that the drilling fluid is:

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* **Abbott v. Coe,** 109 F. (2d) 449, 450, 71 App. D. C. 195, involved the application of the ancient case-hardening process to a cam or cylinder; that case was distinguished from in the decisions cited App. Br. 30-36. **Aeration Process v. Kidde,** 170 F. (2d) 437, C. C. A. 2, involved whipping of cream with nitrous oxide, in which reliance was had upon "taste," p. 429, as distinguished from the employment of carbon dioxide. In **Aeration Process v. Lange,** 196 F. (2d) 981, C. C. A. 8, disagreed with the Second Circuit and held the patent valid. **In re Pollack,** 175 F. (2d) 587, C. C. P. A., simply involved "a new use for composition not disclosed in the patent application," first syllabus.

> "maintained during the course of drilling at a pH of about 12, viz., between 11.5 and 12.5, **by addition** thereto of an **alkaline earth metal** oxide or hydroxide."

The Commissioner's Contention as to Non-Compliance of the Claims With R. S. 4888 With Respect to Magnesium Oxide Has No Basis in This Case.

The Commissioner's Counsel's contention, Appellee Br. pp. 6, 11-13 (as to magnesium oxide), that the claims here involved should be refused because of overclaiming, is indeed surprising to Plaintiff's Counsel for the following reasons: Counsel admit, p. 11, that "the Court made no finding" and that "this issue was not raised by the pleadings", but that "it was urged below". What Counsel omit to say is the following: The Complaint, paragraph 4, App. 2, alleged **compliance with R. S. 4888,** 35 U. S. C. 33; the Answer, paragraph 4, App. 5, **admitted** the allegation except as to claim 17 not in issue. The answer further relied upon what was relied upon by the Examiner and the Board of Appeals who did not even mention magnesium. In spite of all that, we said in Plaintiff's Reply Brief before the District Court:

> "We do not contend that the Commissioner should be precluded from amending his answer, but no such amendment has been asked."

No permission to amend the answer was ever asked by the Commissioner's Counsel. We however went further, namely; in order to avoid any controversy on a point which we did not deem was determinative, in that same Plaintiff's Reply Brief, **we offered** to take out of the specification and claims all reference to the oxides and hydroxides of magnesium, App. 79, and even to restrict the entire case as to disclosure and claims to calcium oxide and its hydroxide. A proceeding of that kind is not unusual at all in a case under R. S. 4915.* The reason there is nothing unusual about that is that after a proceeding under R. S. 4915, the case goes back to the Patent Office anyway, and it is quite usual that the attorney and the Examiner agree upon changes before final allowance. As a matter of fact, where, in any case, an objection is for the first time raised even before the Board of Appeals, then Patent Office Rule 106 (B) specifically provides that the applicant be given an opportunity to "submit an appropriate amendment."

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* **Ratheon Co. v. Coe,** 68 App. D. C. 255, 96 F. (2d) 527, 529:

> "* * * While it is incumbent upon an applicant plainly to state the scope of his invention or discovery in accordance with R. S. § 4888, * * * it should be kept in mind that claims are interpreted with reference to the specification and drawing. * * *"

As noted above, the Commissioner's Counsel did not ask permission to amend his answer and since the District Court dismissed the bill, nothing could at that time be done about the amendment to the specification; although if this Court reverses the District Court, Plaintiff's Counsel assures this Court that the amendment offered will be made.

The District Court's decision **did not mention** the insufficiency of the claims under R. S. 4888 in his opinion. Furthermore, the Findings of Fact and Conclusions of Law **do not mention** that either, and those were drafted by the Commissioner's Counsel. It is therefore rather strange that this defense be brought up again. However, we will discuss it further.

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* In Minnesota Co. v. Coe, 28 F. S. 83, right, Judge Luhring permitted an amendment to be made to a claim in suit. In National Lead Co. v. Kingsland, C. A. 2, 744-48, Mr. Schimmel, who, as here, represented the Commissioner of Patents (while Mr. Bruninga represented National), argued that the claims were too broad by specifying "subjecting such a fluid to distillation with steam" and by not specifying any particular temperature. Judge MacGuire, however, permitted the claims to be amended, by specifying "at a temperature not in excess of 350° F.," and the application was allowed.

The reference is to magnesium oxide and its hydroxide, **simply mentioned** in the application in suit, App. 70, as another alkaline earth metal oxide or hydroxide which "may" "in many instances be employed." Farnham was cross-examined as follows, App. 51-52:

> "**Q.** May I ask you whether in your opinion the alkaline earth oxides used is magnesium oxide? **A.** An alkali earth oxide is magnesium hydroxide. **Q.** Or oxide? **A.** Or oxide, and also the calcium. **Q.** Do you know that you can attain **pH 12.12**, about, with magnesium oxide? **A.** A little **lower than that.** I am not certain as to the maximum pH that will be attained by magnesium hydroxide. **Q.** If you will refer to the table of pH values, to be Defendants' Exhibit 3, there is a statement there that the magnesia will attain **pH 10.5.** **A.** That magnesia is magnesium hydroxide. **Q.** Magnesia—that would be magnesium hydroxide, would it? **A.** Yes, magnesia means magnesium oxide, and saturated with, in the case that it was in water and had hydroxide form, that is the maximum pH attainable. **Q.** If that be true, wouldn't it be impossible to operate this process with magnesia? **A.** There would be—you are referring now to substituting magnesium for calcium hydroxide? **Q.** Correct, to attain all the advantages of reduced viscosity. **A.** You could **obtain the advantages** of reducing viscosity as regards the probable fermentation of the starch. You are getting **fairly close** to the border line there. **Q.** You wouldn't call **pH 10.5 about 12,** would you? **A.** Oh, no. **Q.** And if the claim of maintenance of mud fluid at a pH of about 12, or attaining a mud fluid containing starch at a pH of 12, would it do either one of those? **A. Not with magnesium alone,** no, sir."

There was **nothing** in that testimony that magnesium oxide or its hydroxide are **inoperative** when used in connection with gelatinized starch in a drilling fluid, but simply that you are getting "fairly close to the border line there". Of course, pH 10.5 **in numbers** is not pH 12 mentioned in the claim, although the claim says "**about** 12". Furthermore, there is nothing in the specification, App. 79, **which requires** the use of any of the alkaline earth metal oxides and hydroxides including magnesium "**alone**". The case is, therefore, entirely different from the decisions cited in Appellee's Brief, p. 12.*

Finally, the inclusion of magnesium oxide and its hydroxide can well be considered **surplusage**; that is particularly so since magnesium oxide is **not included** in the definition of an alkaline earth metal oxide in the standard chemical distionary, namely, **Hackh's** Chemical Dictionary, 2nd Ed., p. 35, as follows:

> "**a. earth metals.** The bivalent elements, **Ca, Sr, Ba,** of the second group in the periodic system. **a. earths.** The oxides of **Ca** and **Ba** (lime, baryta)."

Obviously a standard scientific dictionary should be given preference over a general dictionary such as Webster's, referred to in Appellee Br. 11. Whether or not magnesium oxide will produce a pH of 12 is not of moment. The most that can be said is that it should not have been included in the specification of the application where the claims specified a pH of about 12; Plaintiff's Counsel offered to cancel magnesium oxide and its hydroxide, see pp. 28-29, supra.

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* **The Incandcscent Lamp Patent Case**, 159 U. S. 465, involved an electric lamp filament of "a carbonized fibrous or textile material," p. [illegible]59. Of over 6,000 fibrous textile materials tested, only 3 species of bamboo were found useful for that purpose, pp. 472, 473. **Corona Co. v. Dovan Corp.**, 276 U. S. 358, involved a situation, p. 385, where between 50 and 100 of the substances answered the description of the claims and "quite a number" were not accelerators at all. In **American Chemical Paint Co. v. Firestone Steel Products Co.**, 117 F. (2d) 927, C. C. A. 6, the expression used in the claims covered 678 known substances. Of these, 5 out of 27 were good, 8 out of 14 were slightly effective, and 9 out of 18 were ineffective, p. 929. In **Kalle & Co. v. Multazo Co.**, 109 F. (2d) 321, C. C. A. 6, the claims included compounds "which do not answer the description of the specification," p. 325, right, because "the claims as written are broad enough to include compounds which do not have the anhydride or quinonoid structure," p. 324, left.

The following two cases support our position:

> ". . . We think that it cannot be **presumed** that one skilled in the art **would choose** the inoperable process in preference to the operable one . . ." 123 F. (2d) **Electric Storage Battery Co. v. Shimadzu**, 890, 897, C. C. A. 3.
>
> ". . . **The worst** that can therefore be said is that a practitioner, not finding hydrochloric acid forbidden, might **disregard** both the examples and the 'preferred method' and fail. As we have just said in connection with times and temperatures, it does not seem to us that **such a person would stop** at that if he were in earnest; or that, if he were reasonably adept, he would need invention to turn either **to the examples**, or to the 'preferred method.' Nobody would be likely to go into commercial production without some experimental trial of the process; if he did try it, his **vade mecum was at hand** within the four corners of the document." **Catalin Corporation of America v. Catalazuli Mfg. Co.**, 79 F. (2d) 593, 595, C. C. A. 2.

CONCLUSION.

It is believed that this Court will come to the conclusion that the Applicants have made a real contribution to this art, and that it finds no disclosure in the prior art. Surely, an advance in this art, which has been found so important, that in a few years it has replaced what was previously used on a basis of 4 to 1, should not be denied patent protection because of prior art which did not and does not disclose such an important invention. The application of the doctrines of Res Adjudicata, Stare Decisis, or the

Law of the Case should not result in a decision against Plaintiff-Appellant in this case.

Respectfully submitted,

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